SEPTEMBRE 1976

ifra

techniques de presse

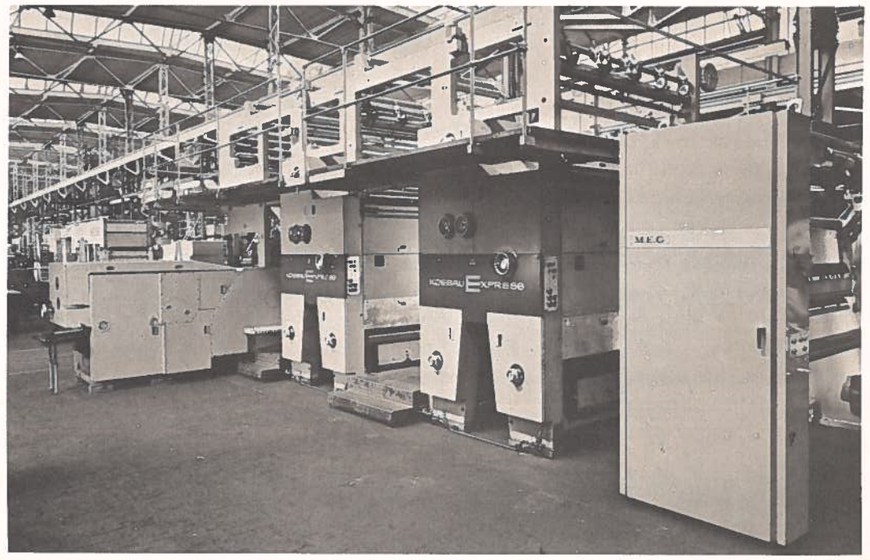
publication mensuelle de l'INCA-FIEJ Research Association

Début des activités du groupe de projet de l'IFRA «terminaux à écran»

Si l'introduction de nouvelles technologies doit apporter des gains maximaux, les directions d'entreprises et les collaborateurs doivent alors se mettre d'accord sur les objectifs liés à cette innovation et collaborer harmonieusement. Toutefois, un changement de ce genre s'accompagne inévitablement d'un certain degré d'insécurité. Des directions d'entreprises, on exige des connaissances nouvelles pour la sélection et l'introduction des nouveaux moyens de production. Quant aux collaborateurs, ils doivent abandonner une partie de leurs aptitudes traditionnelles pour acquérir des aptitudes nouvelles. Par conséquent, si l'on tient à minimiser les risques de conflits, il est dans l'intérêt même des fabricants, des directions d'entreprises et des collaborateurs que les aspects humains soient placés au même rang — lors de la conception et de l'utilisation des nouveaux moyens de production — que les considérations de rentabilité.

L'un des plus importants développements actuels dans l'industrie des journaux est l'introduction d'appareils et de terminaux à écran dans les rédactions, les départements annonces, les ateliers de composition et les autres domaines. Entre-temps, l'IFRA s'est chargée de l'élaboration d'une vue d'ensemble des expériences faites jusqu'à ce jour avec des terminaux à écran (voir page 4 de ce bulletin), afin de permettre aux fabricants et aux directions d'entreprises de journaux de s'orienter plus aisément quant à la conception et aux conditions de travail de ce nouvel outil. Ce premier pas a conduit à un second, à savoir à une mise en contact des trois écoles européennes de premier plan pour les sciences du travail et l'ergonomie. Avec leur aide, on doit étudier soigneusement et objectivement — pour l'industrie des journaux — les aspects humains de la conception des terminaux à écran et du travail à ces derniers.

Le groupe de projet mis sur pied à cet effet comprend le *Prof. Dr-Ing. A. Armbruster* (Institut pour les sciences du travail près de l'Université technique de Berlin), le *Dr T. Stewart* (Département pour les sciences sociales près l'Université de Loughborough, GB) et le *Prof. A. Wisner* (Ecole d'ergonomie et physiologie du travail près l'Université de Paris) en tant qu'experts scientifiques, ainsi que *P. Jaume* (Directeur technique



La première semaine d'août dernier, la nouvelle rotative Koebau-Express de Koenig & Bauer fêtait sa première. Elle est avant tout conçue pour des journaux avec tirages moyens. Voir les détails à la page 44 de ce bulletin.

IFRA
Washingtonplatz 1
D-6100 Darmstadt

Dilitho im Zeitungsdruck – eine Bestandsaufnahme

Die Entscheidung zur Umstellung auf Dilitho

– Zusammenfassung der wichtigsten Argumente dafür und dagegen

Technische Überlegungen zu der Umstellung auf Dilitho

– Gegenwärtiger Zustand der Druckmaschine
– Technische Beschreibung der 16 zur Zeit verfügbaren Feuchtwerke für Dilitho
– Verkupferung der Farbverreiber
– Drucktücher und Untertücher
– Sattel- und Spannsysteme
– Ausbildung und Instandhaltung

Technische Überlegungen zum Druck im Dilitho-Verfahren

– Anforderungen an die Reproduktionen
– Papier und Bahnverhalten
– Druckfarben
– Feuchtwasserzusätze
– Druckqualität

Vollständige Referenzlisten*

– Von U.S. Dilitho-Zeitungen
– Von Skandinavischen Dilitho-Zeitungen

* Stand 1. September 1976

DEUTSCHE FASSUNG verfügbar im Dezember 1976
Wird IFRA-Mitgliedern kostenlos zugesandt
(separate Bestellung unnötig)

Die englische Version wird kostenlos an die Teilnehmer des IFRA-Dilitho-Symposiums verteilt (Hamburg, Oktober 5/6)

Preis für Nicht-Mitglieder: DM 100,–
(bitte Bestellschein verwenden)

ifra – report

direct litho graphy

Prepared by – erarbeitet von – préparé par

IFRA ROTARY PRESS COMMITTEE

IFRA, Washingtonplatz 1, D-6100 Darmstadt

The Status of Dilitho in Newspaper Printing

The Decision to Convert to Dilitho
- Summary of advantages and disadvantages

Technical Aspects of Conversion to Dilitho
- Condition of existing press
- Technical descriptions of 16 currently available dilitho dampening systems
- Coppering the ink drums
- Blankets and packings
- Saddles and lock-up
- Training and maintenance

Technical Aspects of Printing Dilitho
- Reproduction requirements
- Plates and platemaking
- Paper and web behaviour
- Inks
- Fountain solutions
- Print quality

Complete Reference Lists*
- of U.S. dilitho newspapers
- of Scandinavian dilitho newspapers

* as of September 1, 1976

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La décision de se convertir au Dilitho
- Résumé des avantages et inconvénients

Aspects techniques de la conversion au Dilitho
- État de la rotative
- Description technique de 16 mouillages pour dilitho actuellement existants
- Le cuivrage des tables
- Blanchets et habillages
- Selles et accrochages des plaques
- Formation du personnel et entretien

Aspects techniques de l'impression Dilitho
- Exigences de la reproduction
- Plaques et traitement des plaques
- Papier et bande
- Encres
- Solution de mouillage
- Qualité de l'impression

Liste complète des installations*
- aux U.S.A.
- en Scandinavie

* au 1er Septembre 1976

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Celles d'entre elles qui
— à cause de l'âge ou de l'état de leur(s) rotative(s) —
désirent conserver la typo (du moins pour l'instant)
n'avaient encore, jusqu'à des temps récents,
que le choix entre les diverses plaques photopolymères
pour l'impression directe ou pour la prise d'empreinte sur flans.
C'est à elles que s'offre maintenant une alternative: la litho directe.
Parmi ses avantages, on peut citer le fait
que la préparation des plaques offset nécessaires peut s'effectuer
plus rapidement et avec moins de frais que celle des plaques photopolymères
et qu'elle constitue la méthode idéale de transition
pour la conversion ultérieure à l'offset rotative.
D'un autre côté, il faut investir des capitaux
dans la transformation de la (des) rotative(s) typo,
les taux de gâche imprimée subissent une augmentation
et on ne peut obtenir sans autre une bonne qualité d'impression.
La décision n'est pas facile.
Mais, bien souvent, il s'avère impossible de la différer davantage.
C'est pour cette raison que maints membres de l'IFRA nous ont pressés de choisir

DILITHO

comme alternative

comme thème d'un Symposium supplémentaire dans le programme annuel en cours.
Il aura lieu les 5 et 6 octobre 1976 à l'hôtel Plaza, à Hambourg,
sous la présidence de *A. M. Nuijten*,
Directeur technique de Nederlandse Dagbladunie à Rotterdam.

Des communications seront lues par les journaux
«Drammens Tidende» (N), «Helsingborgs Dagblad» et «Sydsvenska Dagbladet» (S),
«Kansas City Star», «Middletown Journal» et «Santa Barbara News» (tous aux Etats-Unis)
ainsi que par les fabricants
Bofors-Nohab, Dahlgren, Harris, Inland, Kalle et Wifag.

Veuillez vous inscrire à temps.

Bienvenue à Hambourg!

de l'Entreprise de Presse No 1, Chassieu, F), *J. May* (Directeur des développements du Mirror Group Newspapers, Londres), le *Dr T. Pohlert* (Directeur gérant de la Deutsche Presse-Agentur, Hambourg), *J. Saint-Cricq* (Directeur général de «La Nouvelle République du Centre-Ouest», Tours, F) et *H. Werthauer* (anciennement Directeur technique de Sijthoff Pers à La Haye, actuellement collaborateur de l'Université de Delft) en tant que représentants de l'industrie européenne des journaux.

Ce groupe — le premier de ce genre pour les intérêts de l'industrie des journaux — s'est réuni pour la première fois le 24 août 1976, à Darmstadt. Au cours de la rencontre, on a tracé le cadre des recherches à entreprendre et discuté les buts du projet. Il doit mener à la fixation d'exigences minimales à l'égard des caractéristiques de conception et de service des terminaux à écran, ainsi que vis-à-vis des conditions de travail et d'environnement pour leur utilisation. A cet effet, on prévoit des études sur les genres d'application typiques de terminaux à écran dans des entreprises de journaux. Ce faisant, il s'agit également de rechercher les effets négatifs possibles et les mesures nécessaires pour leur élimination. On escompte que ces travaux seront achevés à la fin de l'année 1977. Tous les résultats feront ensuite l'objet d'une publication.

* Cette publication se base sur une communication lue par l'auteur au cours du Symposium de l'IFRA «Rédaction électronique — mode ou nécessité? » à Amsterdam.

** Cette publication se base sur une communication lue par l'auteur au cours du Symposium de l'IFRA «Methodes modernes pour la vente des journaux» à Paris.

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Les aspects humains du travail à des terminaux à écran

DAVID HART

La vue d'ensemble suivante sur les résultats d'études et de publications relatives à ce sujet a été élaborée comme base pour de futurs travaux de recherche possibles que doit promouvoir l'IFRA. Elle traite les effets physiologiques du travail à des terminaux à écran, la conception du terminal (clavier et écran) et la conception de la place de travail.

Lors du choix d'un système à écrans, la plus importante question est de savoir si sa capacité de production suffit pour les tâches à accomplir. Il existe toutefois une série d'autres facteurs que l'on devrait examiner soigneusement — cela non seulement afin de satisfaire les exigences fonctionnelles, mais également pour tenir compte de l'aptitude au rendement et du bien-être des opérateurs.

Effets physiologiques

On sait que tous les travaux qui forcent une personne à rester pendant de longues périodes de temps dans une position plus ou moins identique et à faire attention à une tâche ou une chose déterminée engendrent des phénomènes de tension et de fatigue dans une mesure toute particulière. L'une des principaux causes de l'augmentation accélérée de la tension et de la fatigue réside dans une certaine incapacité de se détendre, de se reposer vraiment. Des autres industries et des autorités ont fait des rapports sur le surmenage des yeux, sur des maux de tête et sur des phénomènes de fatigue — tout spécialement dans le cas de personnes qui doivent travailler pendant longtemps et sans interruption à des écrans. Jusqu'à présent, il n'y a cependant pas lieu de supposer que les travaux se présentant à des terminaux à écrans dans l'industrie des journaux mènent nécessairement à des problèmes du genre décrit plus haut. Pour cette raison, des plaintes à ce sujet sont demeurées jusqu'ici plutôt une exception que la règle.

Au cours de ces dernières années, diverses études ont été entreprises par des spécialistes en ergonomie, des autorités médicales et des fabricants afin de mieux connaître la nature et les causes des plaintes relatives aux yeux et à l'inconfort chez les opérateurs de terminaux à écran. Malheureusement, seules quelques-unes de ces études se rapportent aux conditions régnant dans les entreprises de journaux ou peuvent s'appliquer à ces dernières de manière suffisamment représentative. Néanmoins, les résultats et les conclusions constituent une aide utile pour l'explication des conditions dans lesquelles on peut s'attendre à des plaintes. Par ailleurs, lesdites études ont permis de mettre en évidence les principales caractéristiques pour la conception et la sélection de terminaux à écran, de même que pour le travail à ces appareils — cela afin de minimiser les risques de plaintes venant des opérateurs.

Surmenage des yeux et fatigue

La plupart des plaintes avaient trait au «surmenage des yeux» (sensation de brûlure, tiraillement spasmodique des muscles oculaires, maux de tête, voire même — dans quelques cas — altération de la vision et de la perception des couleurs). En fait, les symptômes de la fatigue visuelle sont multiples, tout comme le sont donc les facteurs susceptibles d'accélérer la fatigue visuelle durant le travail. Toutefois, tous ces facteurs n'ont pas un rapport direct avec la vision même. Ceux *rapportés aux personnes* sont des anomalies de l'oeil (tels que presbytie, défaut d'accommodation, astigmatisme, etc.), des vices constitutionnels (fatigue, mauvaise santé, fumer, boire, etc.), l'âge et la position de travail.

Bien entendu, les anomalies de l'oeil et les autres conditions susceptibles d'occasionner une contrainte des muscles oculaires augmentent le risque de fatigue visuelle pendant des périodes de travail prolongées. La vue défectueuse est chose courante même chez les jeunes adultes et la règle chez les personnes dont l'âge dépasse 40 ans. Les résultats d'une série de tests effectués avec 500 secrétaires et employés d'administration montrent que l'utilisation de lunettes ne garantit pas toujours l'amélioration de la vue défectueuse. 50% des personnes testées présentaient des troubles non corrigés de la vision, 37% des porteurs de lunettes devaient faire l'objet d'un examen pour de nouvelles lunettes et 69% des personnes testées ne portant pas de lunettes avaient besoin d'une correction de la vue.

Les probabilités de fatigue visuelle lors de travaux nécessitant une constante attention visuelle s'accroissent avec l'âge. La raison de cette constatation réside dans une déterioration générale du système optique. Par exemple, la plus courte distance pour une bonne acuité visuelle passe d'environ 10 à 75 cm durant la vie de travail d'une personne. D'autres phénomènes dus à l'âge — tels que le rapetissement de la pupille et, de ce fait, la moins grande quantité de lumière entrant dans l'oeil — peuvent être compensés dans une certaine mesure par un bon éclairage.

La *position de travail* joue un rôle important en ce sens que l'obligation de rester assez longtemps dans une position plus ou moins statique mène à la fatigue corporelle (et, en outre, à des maux de tête et à des douleurs dans le cou et le dos) et que cette dernière peut accélérer la fatigue visuelle. Par conséquent, il vaut la peine d'attacher une attention marquée à la conception de la place de travail et, en particulier, à la hauteur des sièges et aux hauteurs de travail.

Lors de la sélection du *terminal à écran*, il convient de prêter une attention particulière à la lisibilité de l'affichage — style, hauteur d'oeil, espacements entre caractères et entre lignes, netteté. La lecture du texte devrait pouvoir s'effectuer sans trop d'efforts à la distance normale du travail. Une chose également très importante est la différence de luminosités entre l'écran et l'arrière-plan. Un contraste trop faible réduit la netteté de l'affichage, tandis qu'un trop fort contraste mène à des problèmes d'éblouissement. Il faudrait donc éviter un arrière-plan trop sombre et/ou éliminer la vue sur une fenêtre et les réflexions des fenêtres et les lampes sur l'écran. Comme cause possible des plaintes relatives aux yeux, on cite les fluctuations périodiques de la luminosité de l'affichage sur l'écran (le scintillement ou le papillotement). Il y a quelques raisons de penser que l'ampleur du scintillement dépend non seulement des propriétés de fluorescence rémanente de la couche de phosphore appliquée sur l'écran (plus la fluorescence rémanente est élevée, plus le taux de régénération nécessaire de l'image est réduit), mais également de luminance de l'image (le taux de régénération de l'image augmente avec la luminance de l'image). Afin de pouvoir obtenir un équilibre optimal entre la netteté, l'éblouissement et la perception du scintillement, la luminosité de l'écran devrait être réglable.

De manière générale, on peut énoncer la règle suivante: plus la *période de travail* ininterrompue est longue et plus le *degré de concentration* nécessaire est élevé, plus les probabilités des sensations de tension et de fatigue sont grandes. Des pauses permettant au personnel de se reposer ou d'exécuter d'autres travaux ont réduit la tendance à des phénomènes de tension et de fatigue. Si l'on ne doit pas regarder en permanence l'écran, les probabilités de fatigue visuelle s'avèrent naturellement considérablement plus faibles que dans le cas d'un mode de travail qui exige l'observation continuelle de l'affichage. Des renseignements indiquent que des effets réjudiciables transitoires — tels que fatigue visuelle et perception troublée des couleurs — se produisent après 4 h d'observation ininterrompue de l'écran. Au moins l'une des études montrait que des opérateurs de claviers-perforateurs et des dactylographes subissaient également une importante augmentation de leurs sensations subjectives de fatigue après 4 à 6 h de travail.

Influences de l'environnement

Comme tous les autres équipements électriques et électroniques, les terminaux à écran ne fonctionnent également pas sans aucune perte. Après une longue période de travail, ils sont donc capables d'engendrer de la chaleur et même — s'ils sont en nombre suffisant — de contribuer à l'augmentation de la *température ambiante*. Pour cette raison, on devrait prévoir (si nécessaire) une installation adéquate de ventilation. La seule source importante de *bruit* est le clavier. L'utilisation de touches à fonctionnement silencieux a cependant conduit à ce que les niveaux de bruit se révèlent en tout cas considérablement plus bas que ceux d'une salle équipée de machines à écrire.

En tant que cause possible de la fatigue visuelle et des maux de tête, il fut également question de l'émission de *rayons X*. Comme dans le cas des téléviseurs noir et blanc ou couleur, cette émission dépend de la puissance de sortie de l'alimentation en haute tension. L'attention fut attirée sur l'émission de rayons X au moment de la commercialisation des premiers téléviseurs couleur. Lors de nombreux contrôles de routine, on découvrit que — dans quelques cas — l'émission de rayons X dépassait les valeurs autorisées. Il s'ensuivit d'autres travaux de recherche et de développement, si bien qu'à l'heure actuelle les tubes cathodiques fonctionnant avec une tension inférieure à 25 kV ne sont plus considérés comme un problème. A la suite de réclamations faites par les opérateurs de terminaux à écran des agences de presse AP et UPI, leur syndicat fit entreprendre des mesures d'émission. Contrôlées par le Département du travail des Etats-Unis, ces mesures furent effectuées sur les types d'appareils 1100 de Harris et 5200 de Hendrix. Dans les deux cas, les résultats se trouvaient bien en-dessous des valeurs admissibles, lesquelles renfermaient en outre un très haut coefficient de sécurité.

Le clavier

Plus de 100 ans après l'invention de la machine à écrire, son layout de clavier standard dit QWERTY

* Publiée sous forme d'un rapport de recherches de l'IFRA (No 76/02), une version détaillée peut être obtenue sur demande auprès de l'Institut de l'IFRA (pour l'instant, en anglais seulement; expédition gratuite pour les membres de l'IFRA et contre paiement de 50 DM pour les non membres).

LE TRAVAIL DE NOTRE INSTITUT

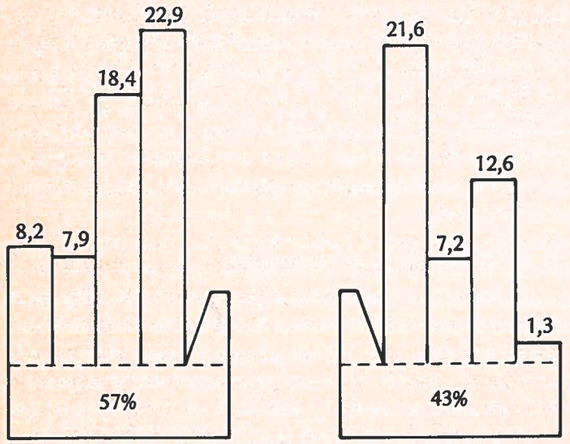


Figure 1: La répartition des frappes (dans le cas de l'anglais) entre les doigts de la main gauche et de la main droite lors de l'utilisation d'une machine à écrire avec layout de clavier standard . . .

(QWERTZ dans le cas du français) est toujours le plus communément mis en oeuvre — également dans le cas des appareils et des terminaux à écran. Et, cela, nonobstant le fait que la main gauche se trouve plus fortement surchargée que la droite et que par ailleurs la frappe ne s'effectue pas assez (30% dans le cas de l'anglais) sur la rangée centrale (rangée de base) des touches à caractères et beaucoup trop (50%) sur la rangée supérieure (voir *figure 1*). Parmi les essais tentés avec plus ou moins de succès pour améliorer cette situation, on peut citer le layout de clavier DVORAK qui reporte la plus grande partie de la frappe à la main droite (voir *figure 2*), d'une part, et qui concentre la

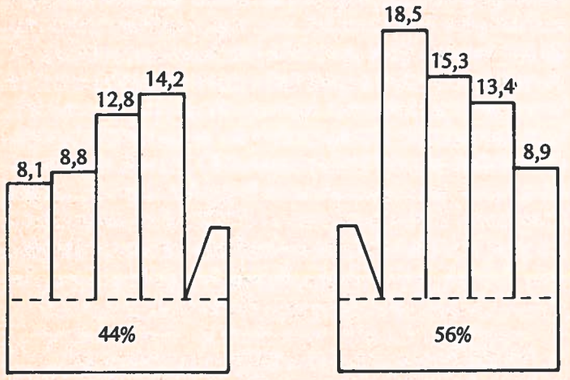


Figure 2: . . . et la nouvelle répartition dans le cas du layout de clavier DVORAK.

frappe sur la rangée de base (70%, le reste se répartissant entre seulement 20% pour la rangée supérieure et 10% pour la rangée inférieure), d'autre part. La disposition des touches à chiffres et à signes a également fait l'objet d'une série d'examens, mais ceux-ci ne menèrent pas à des règles universellement valables. Dans bien des cas, on recommandait uniquement de déplacer quelques signes de la rangée supérieure à la rangée inférieure de touches.

Les appareils et les terminaux à écran exigent un certain nombre de touches à fonctions pour lesquelles il n'existe pareillement pas encore de règles de positionnement. Il serait cependant utile de les positionner à la droite du clavier normal pour les droitiers et à sa gauche pour les gauchers. On a déjà souvent dit que les touches devraient être marquées d'une manière claire et nette. Le marquage a probablement un effet non négligeable sur les temps de formation.

En se basant sur les résultats d'études entreprises par des fabricants et des spécialistes en ergonomie, on peut conclure qu'il existe vraisemblablement une combinaison optimale des *caractéristiques physiques d'un clavier*. Font partie de ces caractéristiques la force requise pour presser les touches (les résultats dépouillés indiquent une plage de 25 à 150 g), la course des touches (1 à 4 mm), la forme des touches (carrée), la grandeur des touches (12,5 x 12,5 mm) et l'espacement entre touches (3 à 6 mm entre les bords, 16 à 19 mm entre les centres). Si la disposition des touches empêche l'opérateur de taper son texte avec les avant-bras à l'horizontale, il peut se produire rapidement des phénomènes de fatigue.

L'écran

La couleur du fond de l'affichage sur un écran est déterminée par les caractéristiques d'émission de la couche de phosphore appliquée sur la surface intérieure de l'écran. Pour autant qu'il s'agisse de la lisibilité, l'acuité optique de l'oeil humain s'avère la plus élevée dans la partie jaune/vert du spectre. Joint au fait que l'une des sortes de phosphores à faible fluorescence rémanente possède des propriétés de transmission maximales dans la gamme verte, la première constatation a conduit à une préférence marquée pour l'affichage de caractères jaunes-verts sur un fond vert foncé. Cette combinaison assure une bonne lisibilité et un bon contraste global. De plus, elle contribue à la prolongation de la durée de vie du tube cathodique. Toutefois, les arguments contraires font

valoir que le vert clair se révèle défavorable pour les yeux et que la combinaison noir/blanc réunit l'avantage d'une bonne lisibilité et d'un bon contraste à un moins fort surmenage des yeux par l'éblouissement. D'autres combinaisons (telles que bleu/gris, vert/noir, orange/ambre, etc.) ont été principalement choisies pour cette même raison. Puisque la lisibilité et le risque de surmenage des yeux dépendent non seulement des seules couleurs, mais également — et plus encore — du rapport entre la luminance de l'écran et la luminosité ambiante — et supposition faite que l'on élimine l'éblouissement —, il est probable que les préférences personnelles pour une combinaison de couleurs déterminée l'emportent sur toutes les autres considérations purement optiques et chromatiques.

La question de la *luminance de l'écran* et, partant, du contraste entre les luminosités des caractères et du fond doit être examinée en relation avec les niveaux d'éclairage dans le local et à la place de travail. Une recommandation dit que la différence des luminosités entre les caractères et le fond ne devrait pas excéder le rapport 3:1 (dans le cas d'un affichage positif des caractères, ce serait 1:3) afin de limiter le risque d'éblouissement à son minimum. Une luminosité des caractères de 80 à 150 cd/m² (en fonction de l'éclairage ambiant) passe pour acceptable. On devrait pouvoir l'obtenir avec une puissance du tube cathodique inférieure à la puissance maximale afain de ne pas raccourcir inutilement la durée de vie du tube. Pour éviter des variations de contraste gênantes dans le champ de vision périphérique de l'orateur, on recommande un rapport de 3:1 à 5:1 entre la luminance de l'écran et la luminosité ambiante.

Les caractères projetés sur l'écran commencent immédiatement à perdre leur luminosité — cela à une vitesse qui dépend du pouvoir de fluorescence rémanente de la couche de phosphore. Par conséquent, il faut renouveler (régénérer) en permanence les signaux. Si le *taux de régénération de l'image* n'est pas suffisamment élevé, l'affichage commence à clignoter ou à scintiller. Ce phénomène est non seulement gênant, il peut également surmener les yeux et les nerfs de l'opérateur. La perceptibilité du scintillement dépend d'un grand nombre de facteurs, dont les plus importants sont la luminosité, la grandeur et la densité de l'affichage sur l'écran, la longueur d'onde de la lumière et l'âge de l'observateur. En règle générale, plus l'affichage est lumineux, grand et dense, plus le scintillement est perceptible — mais la perceptibilité diminue avec l'âge. On peut parer au scintillement soit en revêtant l'écran d'un phosphore à forte fluorescence rémanente (en ce cas, des taux de régénération de l'image entre 30 et 35 Hz s'avèrent suffisants), soit en utilisant des taux de régénération plus élevés (50 à 60 Hz) et un phosphore à faible fluorescence rémanente. Comme les hauts pouvoirs de fluorescence rémanente s'accompagnent usuellement d'une plus courte durée de vie des tubes cathodiques, la plupart des fabricants préfèrent employer des phosphores à faible fluorescence rémanente avec des taux de régénération élevés.

La *génération des caractères* sur l'écran s'opère par un arrangement de points ou de segments de lignes. A vrai dire, la technique la plus généralement utilisée est la génération à l'aide d'une matrice à points. La lisibilité des caractères engendrés dépend très fortement de leur grandeur et de la finesse de la matrice à points. Pour une grandeur de caractères donnée, plus le nombre de points dans la matrice est grand, plus les caractères sont lisibles et — simultanément — plus leur déformation s'avère moindre. Pour une finesse donnée de la matrice, la déformation augmente et la lisibilité diminue avec l'accroissement de la grandeur des caractères. Des matrices avec 5 x 7 ou 7 x 9 points sont considérées comme finesse de définition minimale pour la reconnaissance aussi des minuscules à des distances réduites. On a découvert que l'augmentation de la finesse de définition de 5 x 7 à 12 x 18 points améliore la lisibilité d'une manière décisive. Il faudrait tenir compte de ce fait lors du choix de terminaux à écran pour la rédaction et la correction.

La lisibilité des caractères sur les écrans a fait l'objet d'un certain nombre d'études, au cours desquelles la *grandeur de caractère* (hauteur d'oeil) optimale fut mise en relation avec la distance de lecture, la luminosité de l'image et la finesse de matrice à points. Etant donné la complexité du problème, les résultats présentent une concordance remarquable. Pour une distance de lecture d'environ 70 cm, une hauteur minimale des caractères de 3,1 à 4,2 mm, une hauteur maximale des caractères de 4,5 mm (dans le cas d'une matrice de 5 x 7 points) et un rapport largeur/hauteur de 3/4:4/5 furent tenues pour des valeurs acceptables. La grandeur de caractères préférée augmente avec la luminosité décroissante de l'image, le temps de lecture d'un texte donné diminue avec la grandeur croissante des caractères.

On doit s'attendre à ce que la lisibilité soit également influencée par les *espacements entre caractères et entre lignes*. D'après une recommandation

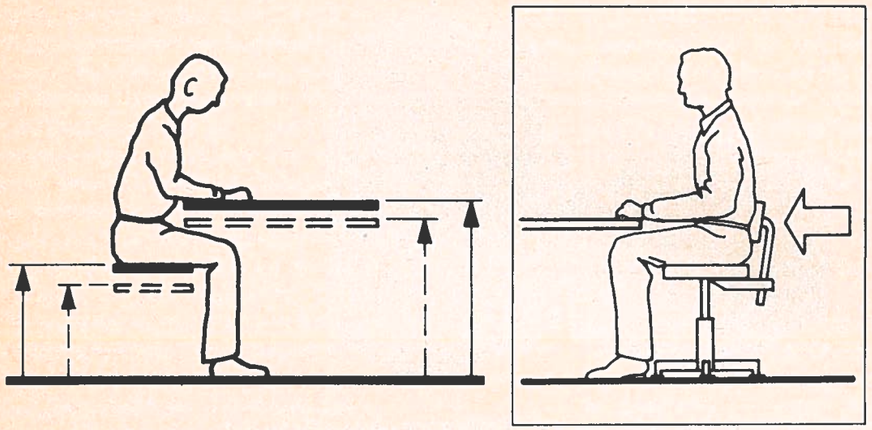


Figure 3: Caractéristiques désirables des chaises et des tables pour les places de travail avec terminaux à écran.

générale, l'espacement entre caractères devrait s'élever à environ une demi-largeur de caractère et l'espacement entre lignes à environ une hauteur de caractère.

Par *contenance de l'écran*, on entend le nombre de champs disponibles pour la visualisation de caractères. Ce nombre se situe usuellement entre 800 et 1500, mais quelques appareils et terminaux à écran peuvent également visualiser 3000 caractères ou davantage. Bien entendu, la contenance optimale dépend du genre des travaux à exécuter. Toutefois, il peut s'avérer utile d'établir un rapport entre la contenance de l'écran et le contenu d'un article de journal typique.

Le continuel mouvement ascendant et descendant de l'affichage sur l'écran devrait pouvoir s'effectuer tant ligne après ligne (pour la rédaction de courtes informations) que «page» après «page» (lors du traitement de textes plus longs). La deuxième méthode est non seulement plus rapide, mais également moins astreignante pour les yeux. A vrai dire, elle ne permet pas la visualisation avec chevauchement de la fin de page et du début de page, si bien qu'à cet endroit l'on doit travailler en plus avec le déplacement ligne après ligne de l'affichage.

L'efficacité du *clignotant* s'accroît avec la densité des informations visualisées. Elle dépend en outre du taux de clignotement. Un taux d'environ 3 Hz fixe suffisamment l'attention de l'opérateur sans que le clignotant ne masque trop fortement le caractère sis en-dessous. Des propositions visent des possibilités pour l'affaiblissement du clignotement — cela afin que le clignotant ne gêne pas ou ne détourne pas l'attention après son positionnement. De manière générale, on devrait pouvoir procéder aisément au positionnement du clignotant et à son déplacement sur toute la surface de l'écran. Par ailleurs, le clignotant ne devrait pas gêner la lecture du signe sis en-dessous et présenter la forme d'un symbole déjà mis en oeuvre pour d'autres buts.

La place de travail

Une bonne position assise s'obtient avec des *hauteurs de chaise et de table* adéquates, donc avec des meubles que l'on peut adapter aux caractéristiques physiques des opérateurs (*figure 3*). Cela s'applique spécialement aux places de travail utilisées par plus d'une personne. La plupart des chaises de bureau conviennent également au travail à des terminaux à écran. Certes, les chaises pivotantes permettent une bonne liberté de mouvement, mais elles devraient comprendre un dispositif de verrouillage afin d'assurer la stabilité nécessaire durant le travail. La hauteur des chaises devrait être ajustée de façon que les opérateurs puissent poser les pieds sur le sol — les jambes étant approximativement à l'équerre avec ce dernier — sans aucune contrainte dans les muscles des jambes et les tendons des pieds. De plus, les chaises devraient comporter un dossier afin de caler le bassin et de faciliter une position assise bien droite. Des chaises roulant sur galets ne sont pas appropriées.

Bien entendu, les tables servant de supports aux terminaux à écran devraient être choisies en fonction du travail à effectuer. Toutefois, une chose primordiale est de prévoir une *place* suffisante pour pouvoir y placer par exemple un téléphone, des copies, du matériel d'écriture, voire une machine à écrire. Les affaires personnelles devraient pouvoir être rangées dans des tiroirs. La hauteur de la table passe pour bonne lorsque l'opérateur peut s'appuyer avec les

avant-bras sur le plateau en se penchant légèrement vers l'avant.

Avec les possibilités de positionnement du terminal à écran dans la bonne position par rapport à l'opérateur (hauteur de la chaise et de la table) et, en particulier, par rapport à la source lumineuse, on peut parer à la sensibilité au surmenage des yeux et aux maux de tête. Pour la plupart des travaux exécutés dans une entreprise de journaux, il est sans doute préférable de placer le terminal en face de l'opérateur de façon à ce que ce dernier puisse voir l'écran à un angle tel que ses yeux regardent légèrement vers le bas. On facilite cette position par un angle d'inclinaison réglable pour l'écran.

L'éclairage devrait permettre tant la lecture de l'affichage sur l'écran que la lecture d'une copie. Il dépend de la puissance de la source lumineuse, de sa position relative par rapport aux yeux de l'opérateur et par rapport à l'écran et, enfin, de la direction de la lumière du jour entrant dans le local. La chose la plus importante consiste à éviter tout éblouissement provenant soit de la vue directe d'une source lumineuse, soit d'un trop fort éclairage (reflets lumineux sur l'écran ou surfaces claires dans le champ de vision de l'opérateur). Il est possible de minimiser le risque d'éblouissement en appliquant une couche antireflet sur l'écran ou en utilisant un verre non réfléchissant. Pour la lecture de l'affichage et des copies, on recommande une intensité lumineuse d'environ 150 lux comme valeur moyenne. La lumière artificielle devrait provenir en grande partie de la même direction que la lumière du jour — tout particulièrement si la source lumineuse n'est pas protégée par un écran. Il importe vraiment que la lumière arrivant à la place de travail soit autant que possible de la lumière indirecte.

Six nouveaux membres de l'IFRA

Depuis notre dernière information relative au complètement de la liste des membres de l'IFRA (état à fin juin 1976; voir «techniques de presse» de juillet/août 1976, page 80), cinq entreprises de journaux et un fabricant sont devenus membres de l'IFRA (état à fin août 1976). En *République fédérale d'Allemagne*, ce sont le «Bergsträsser Anzeiger» à Bensheim, la Werra Verlagsgesellschaft mbH à Eschwege et la firme Kalle (filiale de Hoechst SA) à Wiesbaden-Biebrich, en *Autriche*, le «Tiroler Landeszeitung» à Innsbruck, en *Espagne*, «El Alcazar» à Madrid, en *Iran*, les Kayhan Newspapers à Téhéran.

La commission de l'IFRA pour les rotatives publie un rapport sur la litho directe

L'un des développements les plus remarqués de ces dernières années dans le domaine de la fabrication des journaux fut le mûrissement — jusqu'à un procédé pratiqué pour la production des journaux — de l'impression lithographique directe ou «Dilitho». Maints journaux de la Scandinavie et des Etats-Unis (en particulier ceux avec des petits et des moyens tirages) se sont rapidement aperçus des économies de frais possibles lors de la préparation des plaques — des économies qui peuvent résulter de la transformation de leurs rotatives typo et de l'utilisation de plaques offset relativement peu coûteuses.

Nous savons que de nombreux autres journaux européens envisagent de faire usage de cette possibilité. Toutefois, la décision à prendre pour la conversion à la litho directe n'est pas aisée. Il n'est pas possible d'exprimer tous les facteurs à considérer — et il y en a beaucoup — en ce qui regarde leurs effets économiques. Quel prix doit-on par exemple payer pour la qualité?

La plupart des journaux qui se sont décidés pour le passage à la litho directe reconnaissent probablement franchement que ce procédé renferme certes un certain nombre d'avantages économiques et qualitatifs, mais que ces derniers ne s'avèrent pas si aisément perceptibles dans la pratique qu'il ne le paraissait de prime abord. Pour cette raison, la commission de l'IFRA pour les rotatives prépare présentement une brochure afin de donner une vue claire et précise de la nouvelle technique — un aperçu complet et objectif des caractéristiques et conséquences techniques d'une conversion à la litho directe. Cette brochure sera mise gratuitement à la disposition des membres de l'IFRA et coûtera 100 DM pour les non membres. Une première édition (en anglais) sera disponible pendant le Symposium de l'IFRA «Dilitho comme alternative» les 5 et 6 octobre 1976, à Hambourg (voir page 2 de ce bulletin) dont le président — A. M. Nuijten — dirige également la commission de l'IFRA pour les rotatives à journaux.

La poussière de papier sur des plaques Nyloprint

WALTER CATO OLSEN

La communication suivante a pris naissance dans le cadre d'un projet entrepris par le Chr. Michelsens Institutt (Nygårdsgaten 114, N-5000 Bergen) pour le journal «Bergens Tidende» (un membre de l'IFRA). Dans ce projet, il s'agissait d'établir une comparaison entre l'impression offset et l'impression typo avec plaques Nyloprint lors de la fabrication de journaux et de périodiques (voir à ce sujet «techniques de presse» de décembre 1975, page 4). La reproduction de cette communication — publiée en décembre 1974 en anglais — se fait avec l'aimable autorisation de l'auteur.

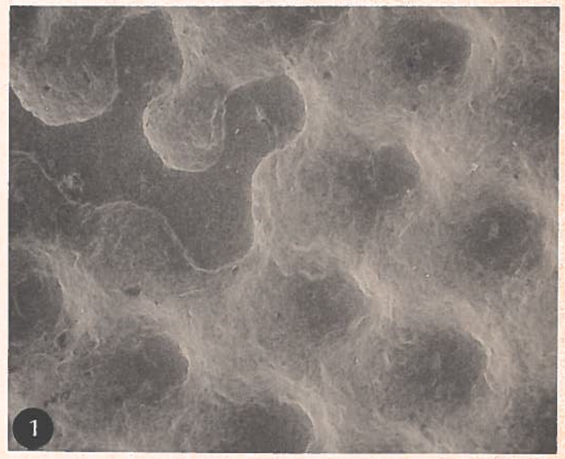
Lors de l'impression de journaux avec des plaques photopolymères, il se produit parfois des points et des taches d'encre indésirables — en particulier dans les parties tramées. L'objectif principal de notre étude — effectuée dans le cadre du projet pour le «Bergens Tidende» — consistait à rechercher les causes de l'accumulation d'encre dans les parties exemptes d'images des plaques Nyloprint utilisées dans le cas particulier. L'étude avait pour deuxième objectif l'obtention d'une collection représentative de prises de vue de plaques Nyloprint à l'aide d'un microscope électronique à scanner — cela afin de pouvoir décrire simultanément des irrégularités quelconques sur les surfaces des plaques.

En ce qui regarde l'encre utilisée pour les prises de vue, il s'agissait de la sorte SN 40006 de la Jacobsens Trykkfargefabrikk à Oslo. Elle a une viscosité de 8,6 cP et un poisseux de 2,0.

Les prises de vue sur cette page (*figures 1 à 3*) se sont effectuées avec une plaque stéréo usagée et lavée. Elles doivent permettre une comparaison de leur surface (plomb) avec celle d'une plaque Nyloprint (photopolymère) representée sur la page suivante (*figures 4 à 6*).

Les échantillons montrés sur les *figures 7 à 9* sont découpés dans une plaque Nyloprint que l'on dut mettre au rebut à cause d'un dépouillement non satisfaisant après l'exposition. A côté d'une zone avec surface normale, on reconnaît une couche indésirable. Dans quelques zones, la couche est partiellement interrompue.

Afin de représenter l'accumulation de crasse sur les plaques utilisées, des échantillons de poussière de papier furent prélevés sur la surface d'une bobine de papier journal et à l'une des plieuses du «Bergens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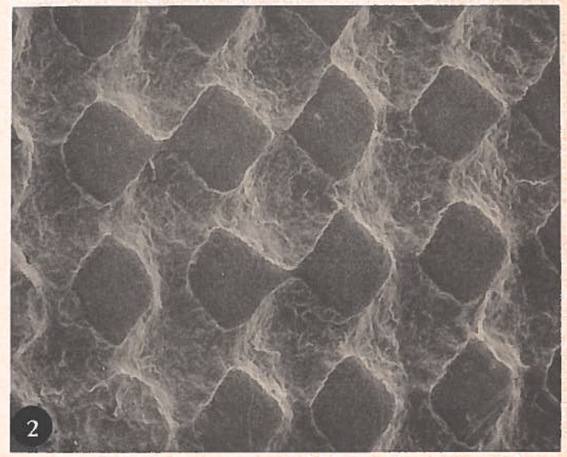
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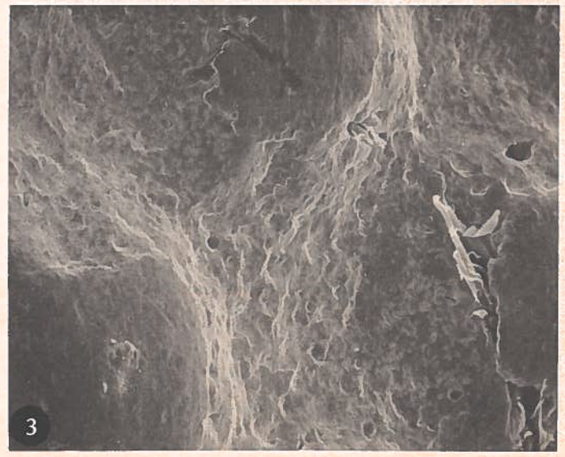
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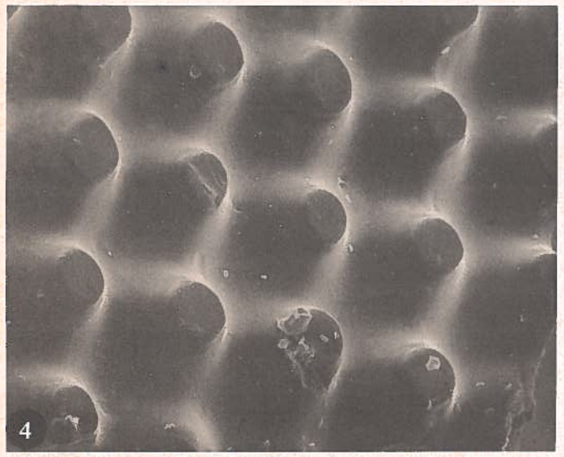
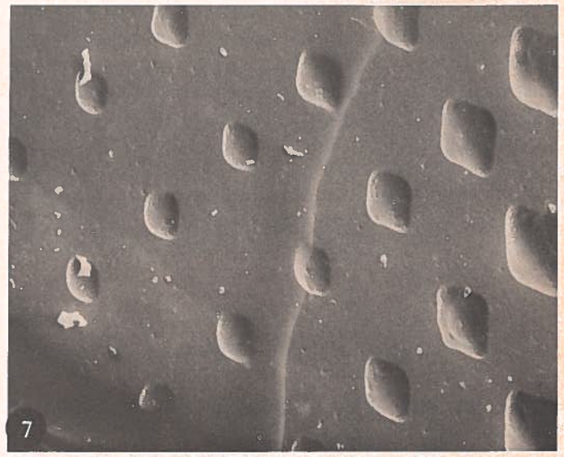
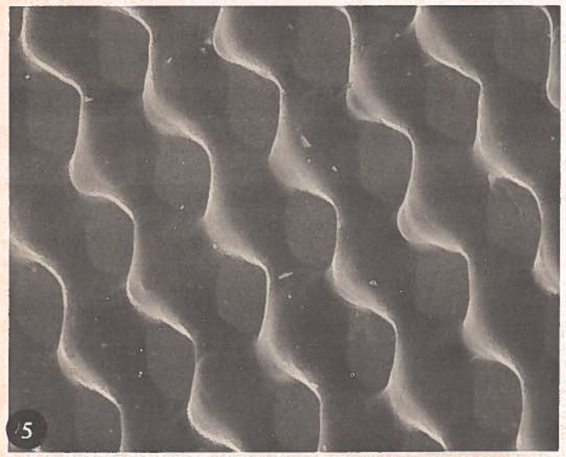
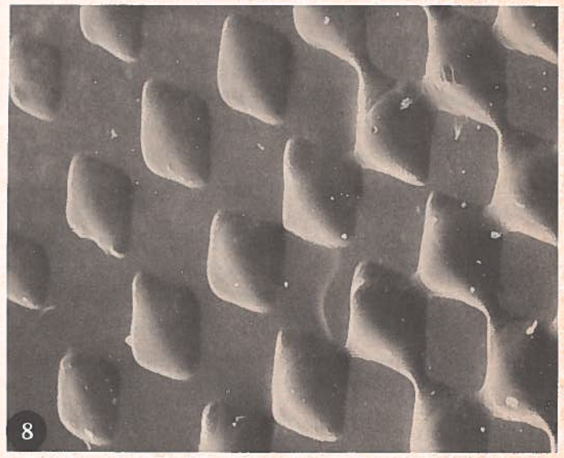
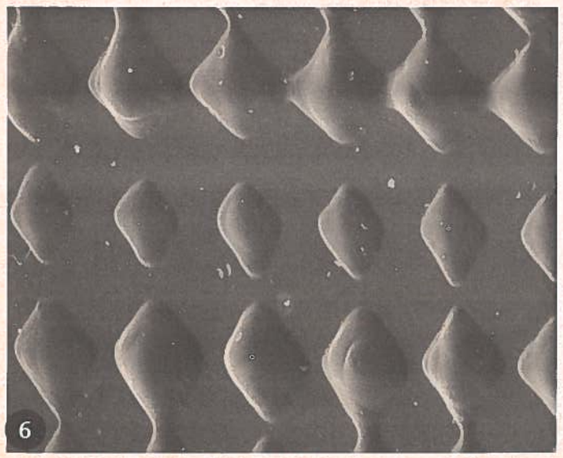
Figures 1 à 3: Surface d'une plaque stéréo usagée et nettoyée; prise de vue avec grossissement respectif de 55 x (1 et 2) et de 150 x.











Tidende». On voit ces échantillons sur les *figures 10 à 13*.

Les *figures 14 et 15* permettent une comparaison entre un morceau nettoyé (14) et un morceau encré (15) d'une plaque Nyloprint. L'aspect de la surface encrée s'avère typique pour toutes les plaques encrées durant l'étude.

Une tache d'encre indésirable — qui se produisit vers la fin d'un tirage dans les exemplaires d'une édition du «Bergens Tidende» (*figure 16*) — a fait l'objet d'une analyse poussée. La tache elle-même fut d'abord photographiée à l'aide d'un microscope optique (*figure 17*), puis la prise de vue de la zone correspondante de la plaque se fit avec le microscope électronique à scanner (*figure 18*). Enfin, un fort grossissement (*figure 19*) représente la fibre de papier supposée comme étant la cause de la tache d'encre.

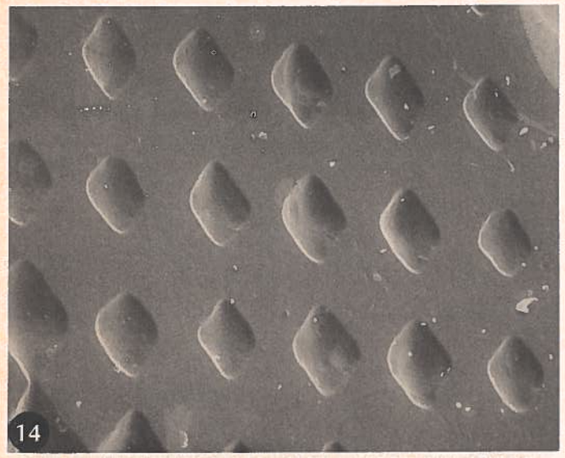
En regardant les *figures 20 à 27*, on peut se faire une idée des quantités de corps étrangers qui se sont déposés sur les plaques utilisées. Avant l'analyse, les échantillons furent soigneusement lavés dans diverses

Figures 4 à 6: Parties de trame d'une plaque Nyloprint; prise de vue avec grossissement de 55 x.

Figures 7 à 9: Parties d'une plaque Nyloprint insuffisamment dépouillée; prise de vue avec grossissement respectif de 55 x (7 et 8) et de 160 x.

Figures 10 et 11: Poussière de papier prélevée sur la surface d'une bobine de papier journal; prise de vue avec grossissement respectif de 100 x (10) et de 180 x.

Figures 12 et 13: Poussière de papier prélevée sur le cylindre de coupe d'une plieuse; prise de vue avec grossissement de 100 x.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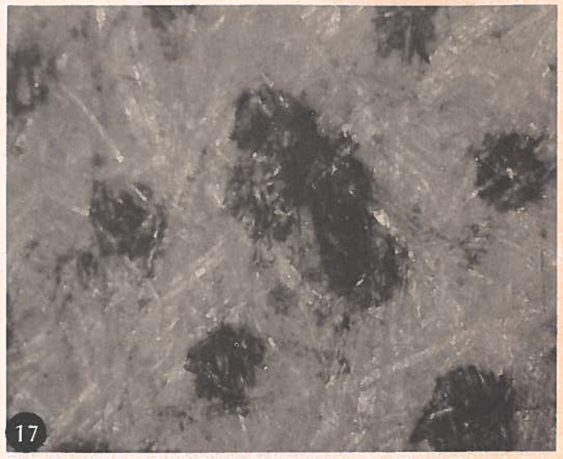
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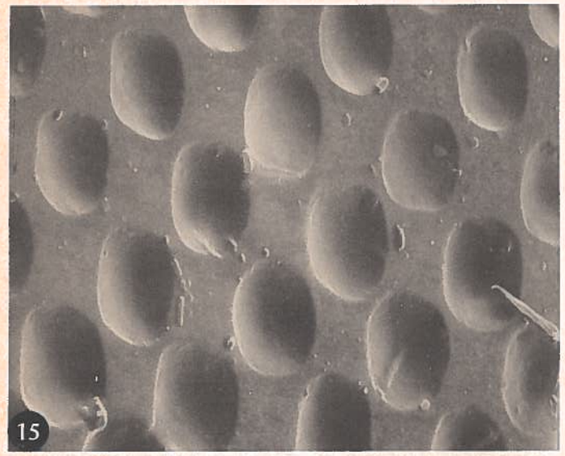
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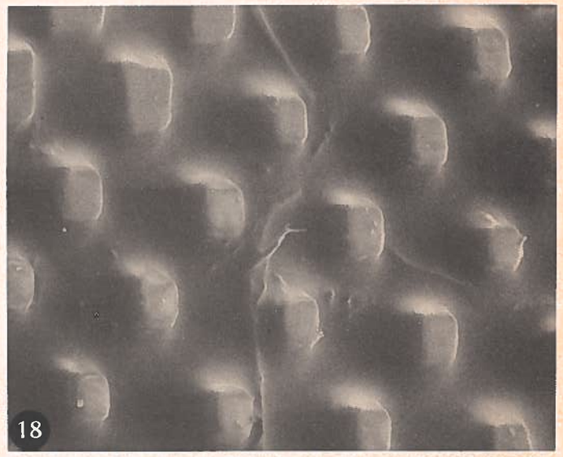
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Figure 14: Plaque Nyloprint exempte d'encre . . .

Figure 15: . . . et plaque Nyloprint encrée; prise de vue des deux avec grossissement de 55 x.

Figure 16: La tache marquée par un réticule dans cette coupe d'un journal (échelle 1:1) . . .

Figure 17: . . . est reproduite ici avec un grossissement de 70 x (sur le papier journal).

Figures 18 et 19: Comme cause probable de la tache d'encre, on a découvert une fibre de papier sur la plaque d'impression. Elle est représentée avec un grossissement de 55 x sur la figure 18 et de 160 x sur la figure 19.


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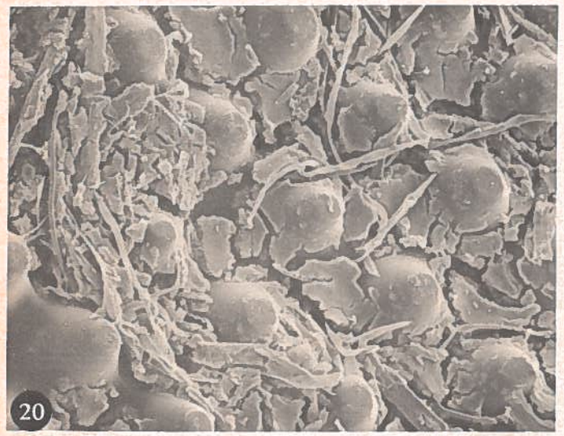
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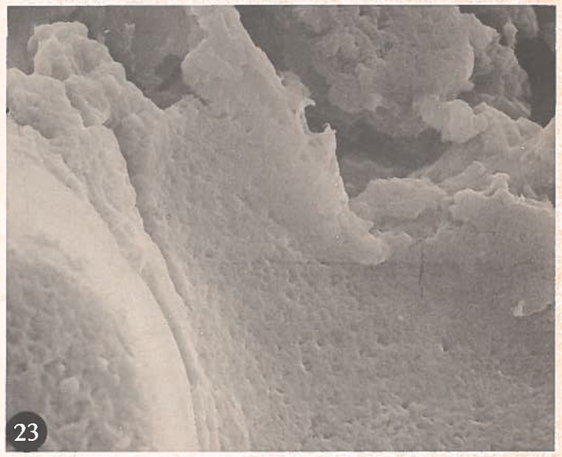
solutions afin d'enlever tous les composants liquides provenant de l'application d'encre. Outre des fibres de papier, il y a également de grosses quantités d'un matériau floconneux, dont on suppose qu'il s'agit de particules de suie provenant de l'encre. Les flocons sont représentés sur les figures 22 à 27 (en partie avec un fort grossissement). Les figures 25 à 27 montrent une collection de fibres et de flocons adhérant sur la plaque que l'on a enlevés de cette dernière et fixés sur le porte-objet du microscope (avec le dessous regardant vers le haut). La figure 25 fait apercevoir l'impression des points de trame dans la face inférieure de l'échantillon. ►

Figures 20 à 24: Plaques Nyloprint encrassées sur lesquelles on a fait disparaître l'encre; grossissement: 20 = 55 x, 21 et 22 = 150 x, 23 = 580 x, 24 = 1500 x.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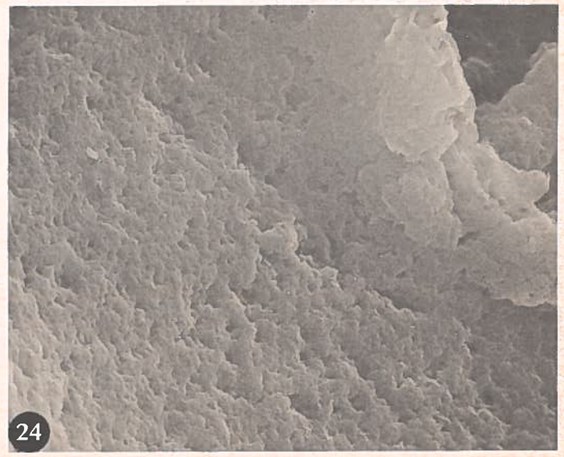
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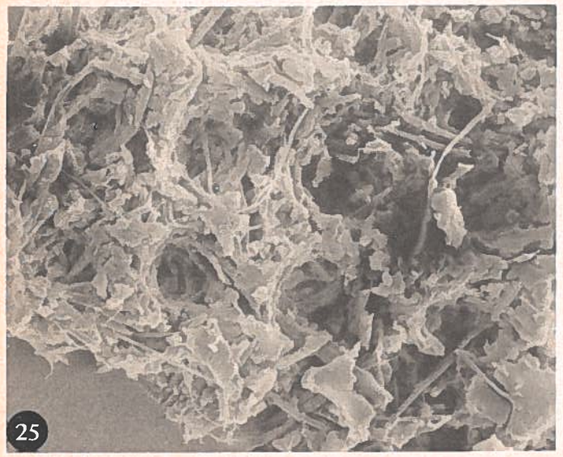
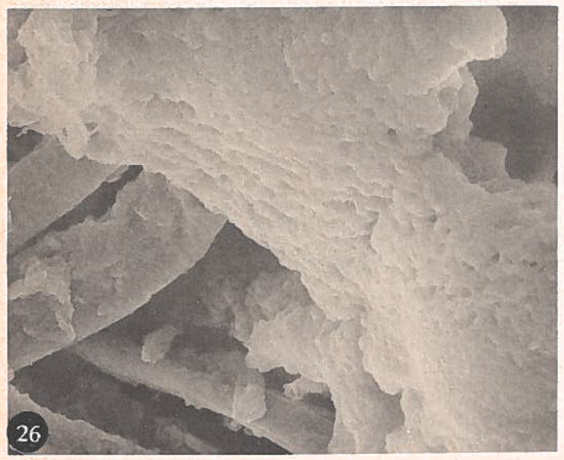
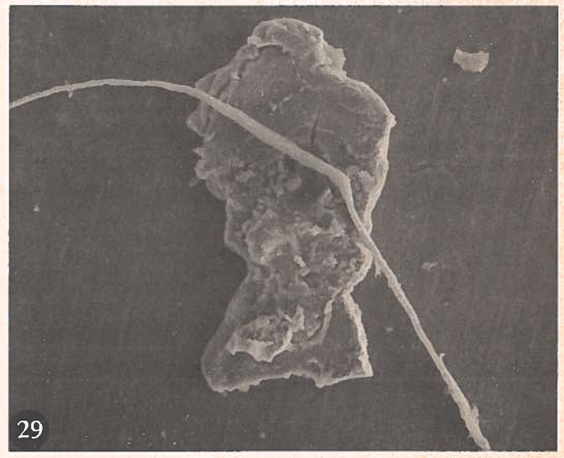
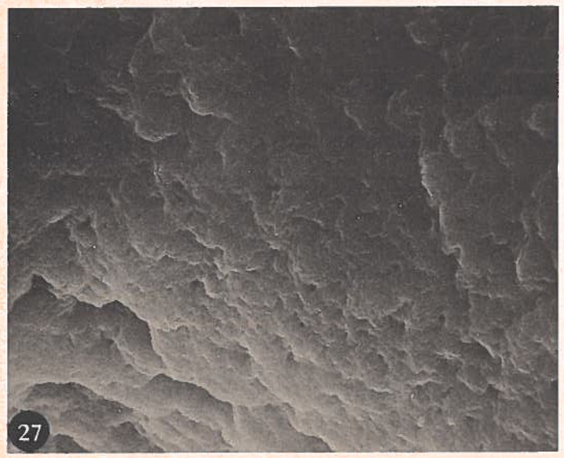
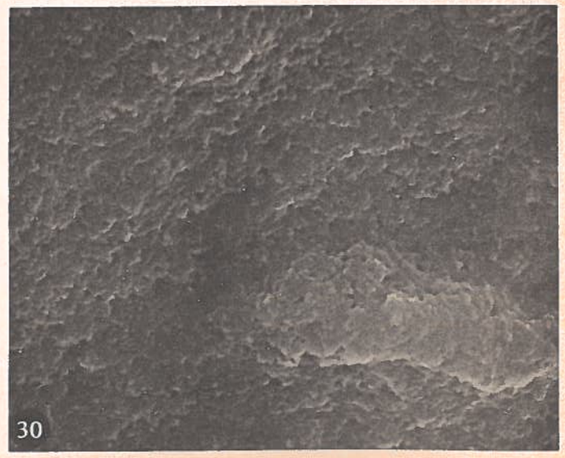










Figures 25 à 27: Dessous d'une couche de crasse séchée prélevée sur une plaque Nyloprint après enlèvement de l'encre; grossissement: 25 = 55 x, 26 = 550 x, 27 = 1500 x.

Figures 28 à 30: Agglomérats de suie extraites d'une encre; grossissement: 28 = 100 x, 29 = 200 x, 30 = 5500 x.

Des agglomérats de suie furent repérés sur toutes les plaques encrées. Par ailleurs, il fut possible d'extraire des particules de suie de quelques échantillons d'encre séchée. Les *figures 28 à 30* en montrent des exemples.

Remarques

Les résultats de l'étude appuient l'hypothèse selon laquelle des points et des taches d'encre indésirables apparaissent sur le papier journal lorsque de grandes quantités de crasse s'accumulent sur les plaques d'impression durant la production. Le composant principal de cette crasse est la poussière de papier. De plus, il y a en outre de quantités considérables d'une sorte déterminée de particules floconneuses. L'examen plus précis des flocons montre qu'ils se composent de particules primaires d'un ordre de grandeur de 1 µm et qu'il pourrait s'agir d'agglomérats de suie.

Si l'on veut venir à bout du problème de l'apparition de points et de taches d'encre indésirables, on doit empêcher l'accumulation de couches de crasse sur les plaques. Un moyen à cet effet consiste à réduire à une valeur acceptable la concentration de poussière dans la salle des rotatives.

Le rôle que jouent les particules floconneuses contenues dans la couche de crasse est moins clair. Elles n'ont vraisemblablement aucun effet direct sur les propriétés d'impression des plaques. Néanmoins, il semble qu'elles agglutinent les fibres de papier tant les unes aux autres qu'à la plaque (voir par exemple les figures 22 à 24). Si tel est le cas, on devrait employer une encre ne favorisant pas l'accumulation de crasse (avec une meilleure distribution de suie) ou – si les agglomérats se forment pendant l'impression – l'encre devrait contenir des additifs qui empêchent l'agglomération de suie. Une autre possibilité – encore que moins attractive – pourrait consister à empêcher l'adhérence de particules étrangères sur le fond de la plaque par imprégnation avec un agent adéquat.

Veuillez prendre note
du Symposium additionnel de l'IFRA
«Dilitho comme alternative».
Détails en page 2.

Les formats de bobines de papier journal — une proposition pour une collaboration

CARL J. HERMACH

L'auteur est vice-président de la division des produits spéciaux de MGD Graphic Systems, à Chicago. Il examine la situation actuelle aux Etats-Unis quant aux formats de bobines de papier journal (spécialement en ce qui regarde les laizes) et demande à toutes les personnes concernées de collaborer étroitement pour la résolution des problèmes en suspens et des problèmes qui s'annoncent. Cette publication se base sur une communication lue par l'auteur à Toronto, le 25 mai 1976, au cours d'un séminaire de la Canadian Pulp and Papier Association (voir également «techniques de presse» de juillet/août 1976, page 72).

La cause principale des modifications enregistrées dans le cas des formats de bobines de papier journal résidait et réside dans l'économie de papier journal. Les rotatives ont déjà été adaptées aux nombreux *laizes* de bobines utilisés. On dispose de porte-bobines qui commandent avec succès la tension de bande et le changement de bobines même dans le cas des plus grands *diamètres* de bobines. Par conséquent, on dirait que tout se passe comme si nous avions satisfait les besoins immédiats de nos clients — les éditeurs de journaux. Hélas, la situation n'est toutefois pas si simple — tout particulièrement lorsque nous examinons pourquoi tous les éditeurs n'ont pas suivi le même chemin lors du choix des formats de pages et des largeurs de bobines (laizes). En fait, il s'agit d'un problème fort complexe.

Lorsque nous nous sommes procuré une première vue d'ensemble de la situation, nous avons constaté que les modifications des formats de bobines affectent non seulement le groupe des entreprises de journaux, mais également les annonceurs, ainsi que les fabricants de papier journal, de machines à papier et de rotatives. Si les laizes tombent en dehors de la gamme située entre 140 et 152 cm, cela touche alors ma firme. Et, si tel est le cas, vous pourriez demander pourquoi nous livrons désormais des rotatives pour des laizes mesurant 15 à 20 cm en plus. Toutefois, le fait important est que la rotative constitue seulement *un* facteur du problème et que l'annonceur, le fabricant de papier journal et le fabricant de machines à papier y ont également leur part.

Campagnes publicitaires nationales	
Télévision	10%
Périodiques	4%
Campagnes publicitaires locales	
Journaux	73%
Radio	7%
Télévision	6%
	100%

Tableau 1: La répartition du budget de publicité du plus grand annonceur du monde (Sears) entre les divers media.

La question décisive est la suivante: De quelle manière pouvons-nous collaborer à la mise au point d'une proposition concernant les formats de bobines de papier journal — une proposition susceptible d'amener des gains tant aux entreprises de journaux qu'aux autres membres de l'industrie? En d'autres mots: Comment pouvons-nous élaborer une proposition valable pour toute l'industrie?

Les annonceurs

Occupons-nous d'abord des annonceurs. Ces derniers se trouvent devant un dilemme, car ils doivent se donner bien du mal avec 255 formats de journaux différents (aux Etats-Unis). Ils aimeraient trouver une issue à cette situation, mais reconnaissent également la grande importance du medium «journal» pour leurs affaires. Ils ne tiennent pas à ce que la place prédominante du journal comme support publicitaire soit compromise par le pêle-mêle des formats et les modifications des laizes (voir *tableau 1*). Les lecteurs de journaux ne sont probablement pas touchés par les nombreuses modifications de formats — à moins que celles-ci ne conduisent à des déformations par rapport à l'original de l'annonce (par exemple, des pneus d'auto ovales au lieu de pneus ronds), si bien que l'annonceur pourrait subir en fin de compte une réduction de son chiffre d'affaires.

Les annonceurs seraient heureux que les journaux puissent se décider pour des formats proches de la norme des années soixante (8 colonnes de 11 picas chacune, 3 points d'espace entre les colonnes, laize de 64 pouces ou de 163 cm). Ils soutiennent les travaux de la commission pour les formats de l'ANPA.

Les éditeurs de journaux et les fabricants de papier journal

Autrefois, quelques éditeurs — spécialement dans le domaine des périodiques, des catalogues et des livres — attachaient de l'importance à un format de produit particulier afin de pouvoir accentuer leur individualité. Mais, tandis que les journaux se battent aujourd'hui encore avec le problème des nombreux formats différents, l'industrie des périodiques et des catalogues a déjà parcouru un long chemin en direction d'un seul format standard d'environ 21 x 28 cm. A mon avis, ce changement a été accompli par des managers modernes qui examinent d'un oeil critique le chiffre sous le trait de l'addition. Je n'aimerais pas suggérer que les

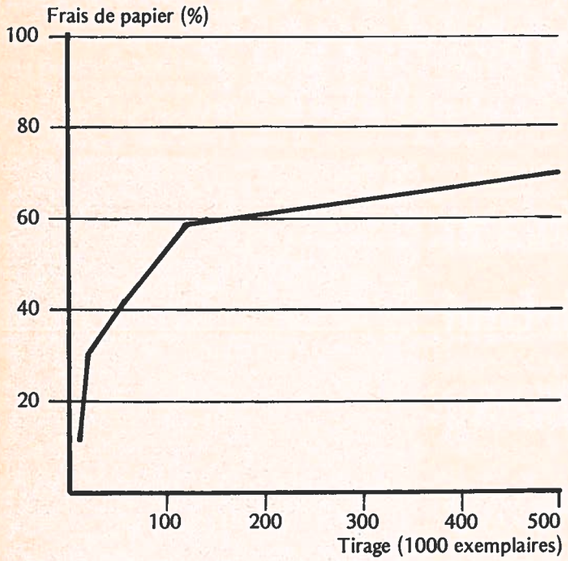


Figure 1: La part des frais de papier dans les frais de production d'un journal en fonction du tirage.

journaux passent également à ce format dans un proche avenir. C'est pourtant une solution possible pour le cas où des besoins accrus occasionnent une forte augmentation des coûts de papier journal et d'énergie et où des mesures — prises par tous les membres de l'industrie pour agir efficacement sur les frais — ne peuvent compenser ladite augmentation.

La standardisation des laizes est réalisable. Ainsi, par exemple, les journaux japonais utilisent des longueurs de coupe et des laizes standardisées. Je ne suis pas d'avis que les journaux américains doivent s'en tirer avec un seul format. Mais je crois cependant à la possibilité d'une réduction considérable du nombre des divers formats auxquels nous avons affaire à l'heure actuelle.

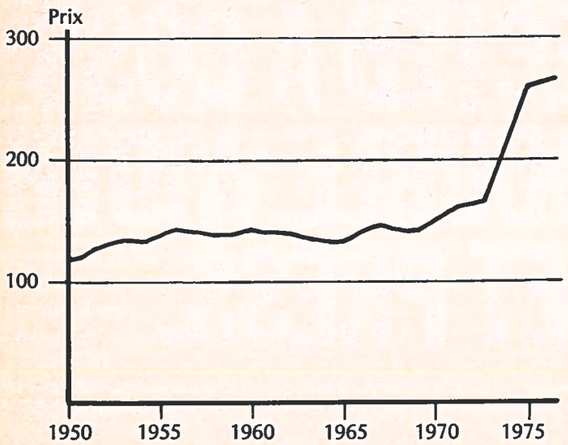


Figure 2: L'évolution du prix du papier journal — valeur effective (dollars/short ton = 907 kg) — aux Etats-Unis durant les 25 dernières années.

L'un des facteurs essentiels qui influencent les laizes est la largeur utile maximale de la machine à papier. On peut refendre six bobines de 55 pouces (140 cm) à partir du produit d'une machine à papier de 330 pouces (840 cm) et six bobines de 60 pouces (152 cm) à partir du produit d'une machine à papier de 360 pouces (912 cm).

Quelques éditeurs de journaux croient qu'une réduction de la laize peut mener à une diminution des frais de papier et, partant, à une amélioration de leur situation financière quant aux gains. Toutefois, une telle manière d'agir peut déboucher dans un cul-de-sac. Ces journaux travaillent avec une laize d'environ 59 pouces (150 cm) et s'opposent à la tendance vers des bobines de 55 pouces. Si les annonces étaient vendues d'après leur surface effective et non pas d'après leurs besoins de colonnes multipliés par la hauteur en pouces, il serait peut-être alors possible de répondre à la question de la rentabilité.

La *figure 1* montre que la part des frais de papier dans les frais de production totaux est plus élevée dans le cas des grands journaux que dans le cas des petits. Par conséquent, les grands journaux sont davantage tentés par une réduction de la consommation de papier journal si la forte augmentation de prix représentée sur la *figure 2* continue son cours. A vrai dire, cette augmentation se révèle plutôt modérée si on la reproduit sans l'inflation — comme sur la *figure 3*. Une autre possibilité pour la diminution des frais de production et pour l'accélération du retour des capitaux consiste à mettre en oeuvre des rotatives de 6 pages de largeur. La réduction du grammage pourrait également jouer un rôle compensateur — à condition toutefois que la diminution de frais ainsi réalisée soit retransmise aux entreprises de journaux et que le nombre de casses de papier ne fasse pas l'objet d'une augmentation.

Donc, trois attraits incitent les éditeurs de journaux à accepter la tendance vers un nombre réduit de formats de journaux et de bobines:

1. Il peut être certain que cette tendance contribue à la conservation de sa situation prédominante par rapport aux autres media publicitaires. ►

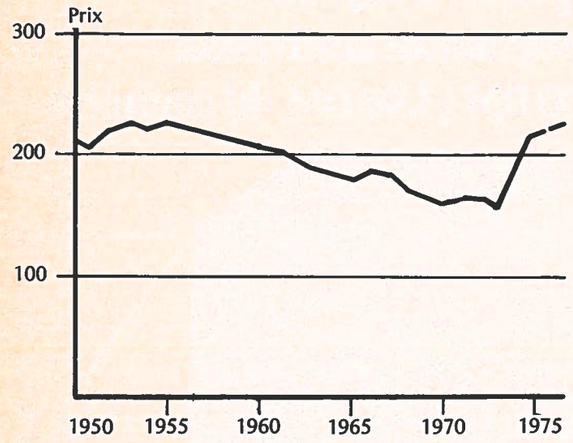


Figure 3: L'évolution du prix du papier journal — valeur ramenée à l'état en 1972 après déduction de l'inflation (dollar/short ton) — aux Etats-Unis durant les 25 dernières années.

2. Il peut s'attendre à ce que les fabriques de papier journal puissent produire avec des frais les plus réduits possibles après une standardisation des laizes — d'où une amélioration des gains tant pour le fabricant que pour l'utilisateur.
3. Il peut partir du fait que les laizes standards sont plus facile à obtenir, d'une part, et livrables à partir d'un plus grand nombre de sources, d'autre part.

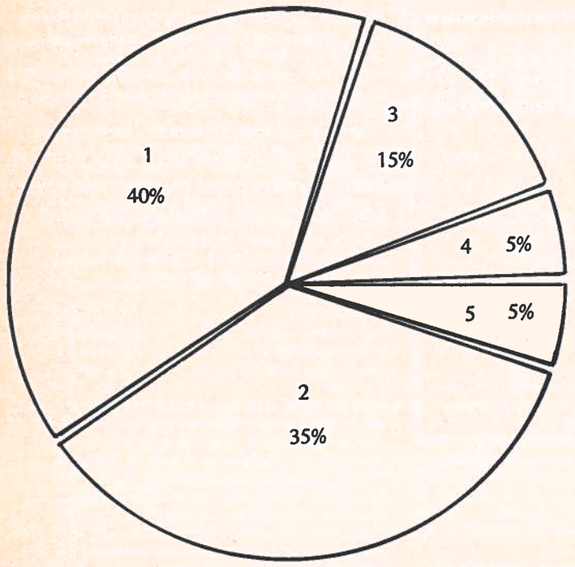


Figure 4: La répartition de la consommation de papier journal aux Etats-Unis entre cinq groupes de tirage (année 1975). 1 = moins de 100 000 exemplaires, 2 = 100 000 à 500 000 exemplaires, 3 = 500 000 à 1 million d'exemplaires, 4 = 1 à 2 millions d'exemplaires, 5 = 2 millions d'exemplaires et plus. On voit que 65% de la consommation totale constituent la part afférente aux journaux avec tirages de plus de 100 000 exemplaires.

Présentement, la plupart des fabricants se sentent incapables de construire de nouvelles fabriques de papier journal, car il leur manque les capitaux nécessaires. Par ailleurs, on croit que l'on pourrait obtenir un meilleur retour des capitaux par la transformation des anciennes machines (accroissement du rendement et de la qualité avec conservation des largeurs). Toutefois, il est probable que les nouveaux développements — dont font partie la fabrication thermomécanique de la pâte mécanique, les toiles doubles, etc. — réduisent les frais de production et améliorent les possibilités de gains, si bien que l'on pourrait à l'avenir repenser à l'achat de machines plus larges et plus rapides.

A l'heure actuelle, quelque 20 entreprises de journaux travaillent avec des bobines de 45 pouces (114 cm) de diamètre. Cela indique une amélioration des machines à bobiner dans les papeteries et des porte-bobines aux rotatives. Par ailleurs, l'industrie du papier journal livre des bobines de 42 pouces (107 cm) de diamètre et de 98 pouces (249 cm) de largeur, ainsi que le format 40 x 94,5 pouces (102 x 240 cm) — des bobines régulièrement utilisées dans les imprimeries hélio — et, en outre, le format 40 x 90 pouces (102 x 229 cm) pour la rotative de 6 pages de largeur que nous avons construite pour le «New York News». Dans le cas de l'utilisation des mandrins présentant une plus haute résistance mécanique, il est parfaitement possible de traiter des bobines dans les formats 50 x 60 pouces (127 x 152 cm) et 45 x 90 pouces (114 x 229 cm), et même le format de bobine 50 x 90 pouces (127 x 229 cm) s'avère techniquement réalisable.

Pour le fabricant, une limitation de la gamme des laizes se traduirait par les avantages et les défis suivants:

1. Lors de l'achat d'une nouvelle machine à papier, le fabricant pourrait compter sur l'exploitation maximale de sa largeur et ne devrait pas s'inquiéter à propos d'autres modifications.
2. La programmation des combinaisons optimales de formats de bobines pour la machine à refendre et à bobiner serait plus aisée, et le fabricant obtiendrait des taux de déchets plus réduits. ▶

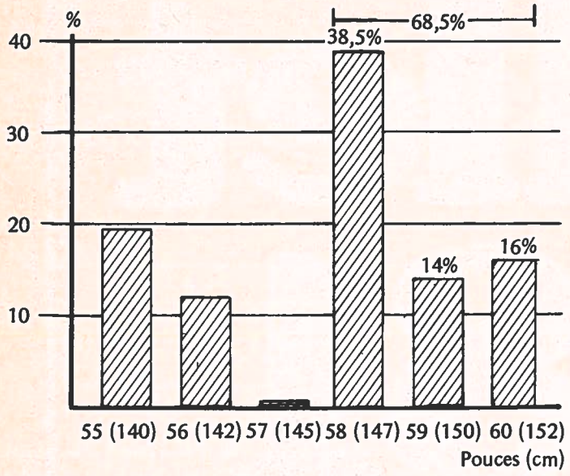


Figure 5: Analyse de la consommation annuelle de papier journal dans les 50 régions de commercialisation les plus importantes des Etats-Unis selon les laizes.

3. Selon toutes probabilités, le prix de la machine à papier s'avérerait plus bas, car le fabricant de papier achèterait un modèle standard.
4. Des nouvelles machines seraient plus productives. Elles contribueraient à un retour plus rapide des capitaux.
5. L'un des objectifs essentiels du fabricant devrait consister en la production d'un papier journal de plus faible grammage avec des coûts relativement plus réduits – cela sans qu'il se produise une augmentation des nombres de casses de papier.

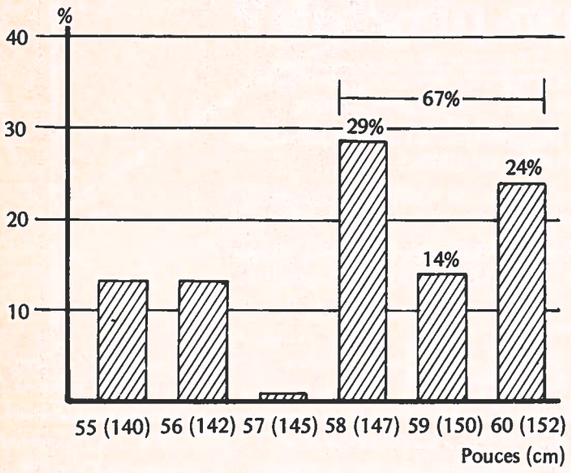


Figure 6: Analyse des journaux dans les 50 régions de commercialisation les plus importantes des Etats-Unis selon les laizes de papier journal utilisées.

Les fabricants de machines à papier

Ils sont en train de concevoir des machines avec une largeur de 1016 cm et un rendement de 1220 m/min. Théoriquement, la productivité d'une telle machine peut être quatre fois plus élevée que celle d'une machine transformée moins large dans la gamme de 508 cm de largeur et de 548 m/min de rendement. Afin de limiter la consommation d'énergie et la pollution de l'environnement, de conserver les réserves naturelles et d'exploiter le plus efficacement possible les matières fibreuses, ces machines pourraient fonctionner en liaison avec des conceptions d'entreprises plus simples et des équipements réduits. En raison de leur productivité plus élevée, on peut fort bien s'imaginer que les nouvelles machines rendraient superflus les anciens matériels et qu'il serait possible de les munir avec une plus grande flexibilité en ce qui regarde leur largeur utile. On dispose de machines à bobiner qui peuvent également produire des bobines de grand diamètre.

Les fabricants de rotatives

Ces derniers ont pareillement reconnu que les éditeurs de journaux déterminent la tendance dans le cas des formats de bobines. Toutefois, ma firme a influencé cette tendance de deux façons:

1. Elle offre une machine de 6 pages de largeur pour une laize de 229 cm.
2. Elle a installé des porte-bobines pour le format de bobine 114 x 152 cm dans maintes nouvelles imprimeries. Par ailleurs, un porte-bobines pour le format 102 x 229 cm a fait l'objet d'une démonstration couronnée de succès lors de la production du «New York News». Selon les rapports reçus de ce journal, on n'a pas observé un accroissement des endommagements de bobines et des taux de gâche blanche par suite du plus grand diamètre de bobine.

Comme le format de bobine 107 x 249 cm est déjà mis en oeuvre avec des mandrins hautement résistants de 10 cm de diamètre, on peut prédire que les mandrins de 10 cm suffiront également pour le format de bobine 114 x 229 cm (pour les rotatives de 6 pages de largeur) s'ils font l'objet d'un autre renforcement. Il faudrait avoir des colles et des papiers à haute résistance, un bobinage spécial et probablement une plus grande épaisseur des mandrins. Nous sommes en mesure de livrer des porte-bobines pour des formats de

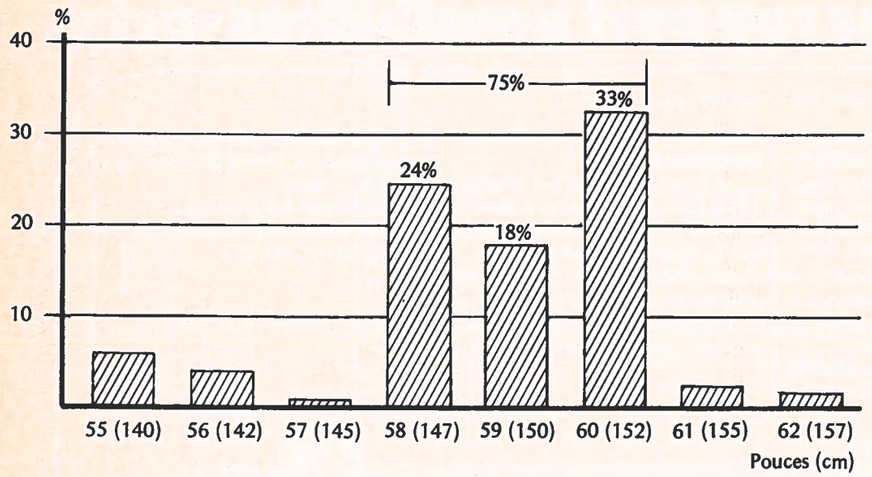


Figure 7: Analyse de la consommation de papier journal dans 500 entreprises des Etats-Unis — équipées de rotatives de double largeur — selon les laizes utilisées.

bobine mesurant 127 x 152 cm et 127 x 229 cm, mais il se peut qu'il faille utiliser des mandrins de plus grand diamètre pour ces formats.

En combinant les avantages de la rotative de 6 pages de largeur (moins de groupes d'impression, moins de bobines, moins de changement de bobines, moins de personnel de service) avec une vitesse d'impression plus élevée (par une réduction de la tension de bande à son minimum absolu et par des nouvelles conceptions de plieuses), des taux de gâche réduits et des commandes automatisées, nous sommes assez sûrs de pouvoir atteindre notre but, à savoir le doublement de la productivité actuellement obtenue avec les rotatives standards. Si l'on songe que la plus grande partie du papier journal canadien exporté aux Etats-Unis est consommée par les grands journaux (voir *figure 4*) et que la part du papier journal dans les frais de production est plus grande pour ces journaux que dans le cas des petits tirages (figure 1), on peut également calculer pour les tirages élevés les plus grands avantages offerts par l'utilisation d'une rotative de 6 pages de largeur. Il serait à nouveau possible d'en déduire une tendance remarquable partant des bobines de 152 cm pour arriver à des bobines de 229 cm de largeur.

Tendances futures

Les *figures 5 et 6* montrent la répartition de la consommation de papier journal entre les diverses laizes dans les 50 régions de commercialisation les plus importantes des Etats-Unis. Elles font reconnaître que la majorité se situe déjà dans la gamme de 58 à 60 pouces (147 à 152 cm). La *figure 7* supporte ce résultat. La tendance vers des bobines de 55 pouces (140 cm) de largeur s'est déjà ralentie — manifestement en raison de réflexions sur tous les facteurs économiques liés à cette grandeur. Si l'on tient compte de cela, il semble que la gamme des laizes de 58 à 60 pouces constitue un objectif raisonnable. Elle convient également à la gamme actuelle des formats tabloïds. Quelques consommateurs sont d'ailleurs revenus des bobines de 55 pouces à la plage de 58 à 60 pouces.

Dans deux ou trois ans, nos rotatives offset de 6 pages de largeur tourneront avec le format de bobine 114 x 229 cm, tandis que des changements de bobines avec le format 127 x 229 cm pourront vraisemblablement s'opérer de manière automatique d'ici cinq ans. Le format de bobine 127 x 76 cm est déjà mis en oeuvre dans des rotatives à journaux de simple largeur.

Mots de clôture

Nous devons nous demander si nous avons tous assez fait d'efforts et si nous sommes tous prêts à fournir une contribution permanente à la résolution des problèmes soulevés par les formats de bobines et à la réduction des frais de production des journaux. Si l'on considère ces problèmes comme un tout, on peut accélérer leur résolution. Une proposition soutenue par tous les membres de l'industrie constituerait un premier pas.

Veuillez prendre note du Symposium additionnel de l'IFRA «Dilitho comme alternative». Détails en page 2.

Les NMPP et leurs nouveautés techniques

MAURICE AUDOUIN

L'auteur — Directeur des Nouvelles Messageries de la Presse Parisienne (NMPP) à Paris — esquisse d'abord l'organisation et les tâches de cette entreprise de distribution collective, puis il s'occupe des installations d'informatique et, finalement, de la salle d'expédition des NMPP à Rungis près Paris.

Depuis avril 1947, les NMPP réunissent les activités de diffusion de cinq coopératives d'éditeurs (une pour les quotidiens, quatre pour les périodiques) avec environ 1600 titres et celles de la Librairie Hachette. Cette dernière a fait apport de ses équipements, de son réseau de distribution et de ses connaissances. Les coopératives d'éditeurs détiennent 51% des parts de l'entreprise, cinq postes sur huit au conseil de gérance et la présidence de ce conseil. Quant à Hachette, elle possède le reste et assume la direction générale des NMPP.

Les tâches

L'entreprise diffuse actuellement la quasi totalité des journaux et périodiques édités à Paris, la plupart des publications de province recherchant une diffusion nationale et la presse étrangère importée. En 1975, ce furent près de 2,4 milliards d'exemplaires (8 millions par jour) avec un poids de 327 000 t et une valeur de vente dépassant 6 milliards de FF (voir *tableau 1*). En 1973 (avant la récession), les chiffres respectifs s'élevaient à 2,8 milliards d'exemplaires et 410 000 t.

La diffusion concerne 1500 périodiques français et 700 étrangers, 15 quotidiens nationaux et 40 régionaux en dehors de leur zone d'édition, de même que 60 journaux étrangers. Le titre le plus important est «Télé 7 jours» avec près de 3 millions d'exemplaires; d'autres ont seulement quelques dizaines d'exemplaires. En France, le réseau de distribution (*figure 1*) comprend 44 000 points de vente servis soit directement par les NMPP (notamment à Paris et dans la proche banlieue), soit par l'intermédiaire de grossistes (dans la plupart des villes).

	Exemplaires (1000)	Poids (t)	Valeur de vente (1000 FF)
Quotidiens	863 000	88 000	1 088 000
Autres publications ..	1 527 000	239 000	5 048 000
Total	2 390 000	327 000	6 136 000

Tableau 1: Rendement de la diffusion des NMPP en 1975.

La compétence des NMPP inclut l'enlèvement des produits aux imprimeries, le comptage, l'emballage et l'expédition (ou aussi le transport) des exemplaires, la récupération des invendus, l'actualisation des quantités à livrer (en fonction des demandes du réseau de distribution et des instructions des éditeurs), ainsi que la facturation et l'encaissement des ventes. Par ailleurs, des informations commerciales sont tirées tant du système comptable (statistiques de ventes pour les divers titres et les diverses villes) que de systèmes spéciaux (en particulier d'un panel représentatif de 550 points de vente sondés deux fois par semaine). ▶

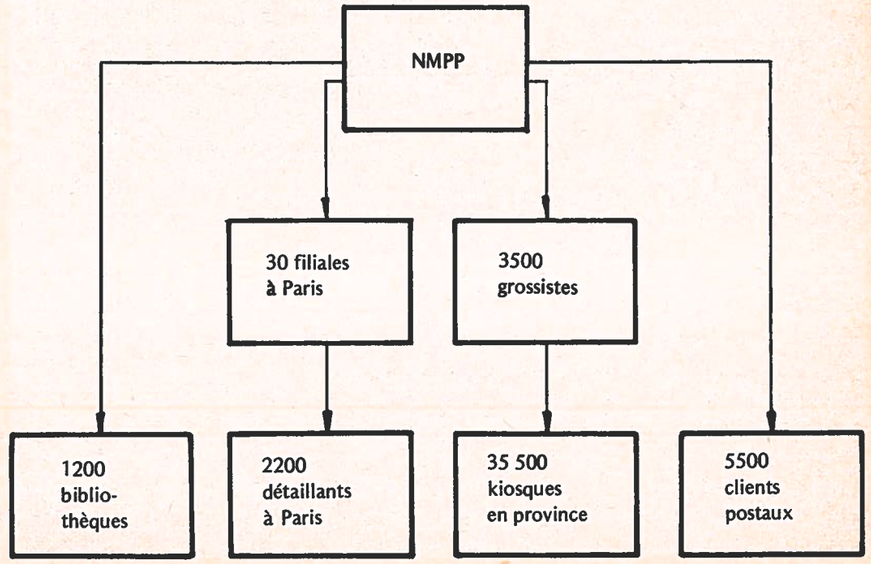


Figure 1: Le réseau de distribution des NMPP.

Figure 2: Salle des ordinateurs des NMPP à Paris avec mémoires à disques magnétiques au premier plan et unités centrales au fond (dans «techniques de presse» de juin 1976, page 1, on trouve une photo du pupitre de commande et de l'unité centrale d'une des deux installations d'informatique IBM 370/168 des NMPP).

La règle coopérative et l'égalité des chances président au fonctionnement de l'entreprise. Les tarifs de la diffusion sont fixés par les coopératives. Ils concordent pour tous les titres ayant le même prix, le même poids et le même chiffre de vente. Quelle que soit son importance, chaque éditeur dispose d'une seule voix dans les assemblées générales.

Genres de coûts	
personnel	50%
transports	21%
bâtiments, matériaux, frais généraux	29%
Fonctions des coûts	
expédition	60%
invendus	9%
informatique	11%
comptabilité et gestion	14%
relations avec les éditeurs etc.	6%

Tableau 2: Répartition de la part des NMPP dans les frais de distribution (12,1% du prix de vente des exemplaires) entre genres de coûts et fonctions des coûts.

En dépit des inévitables difficultés dues au grand nombre de titres et aux différences entre eux, les NMPP ont fait la preuve de leur efficacité. Sur le plan technique, elles mettent en oeuvre les moyens les plus modernes et les plus performants; sur le plan économique, elles ont permis une réduction des frais. Lors de la création des NMPP en 1947, les frais de diffusion avaient une part de 44,23% dans le prix de vente de l'exemplaire. En 1975, cette part ne s'élevait plus qu'à 37,20%, dont 12,10% seulement sont consacrés aux NMPP (voir *tableau 2*). Le reste (25,10%) représente la rémunération du réseau de distribution (grossistes et détaillants). Bien sûr, ce taux de 37,20% constitue une valeur moyenne, car les barêmes des coopératives

Figure 3: Salle des appareils périphériques (unités de bande magnétique et terminaux à écran) dans le centre d'informatique des NMPP.

Figure 4: Cinq des sept imprimantes rapides au centre d'informatique des NMPP.

varient en fonction du chiffre de vente, du prix unitaire et du poids des différents titres. Les taux s'étagent de 34 à plus de 50% du prix de vente. En fin d'année, les excédents d'exploitation sont ristournés aux éditeurs membres des coopératives en proportion de leur chiffre d'affaires.

Le centre d'informatique

Les installations à cartes perforées de l'année 1947 furent remplacées en 1961/62 par deux ordinateurs IBM 7074 et IBM 1400 puis, en 1968, par deux ordinateurs IBM 360/65 et finalement, en 1975, par deux ordinateurs IBM 370/168. Deux unités centrales avec chacune une mémoire interne de 4 MB sont directement raccordées à un grand nombre de mémoires externes et d'appareils périphériques – notamment à six unités de disque magnétique avec 36 disques et une capacité totale de plus de 7000 MB, à cinq imprimantes rapides (deux autres fonctionnent comme unités indépendantes) et à deux réseaux de terminaux (un réseau local et un réseau pour le télétraitement des données).

Les installations d'informatique se chargent des tâches traditionnelles telles que facturation, comptabilisation, établissement de statistiques, etc. par un traitement par étapes des données («batch»). Tous les travaux qui exigent l'accès à différentes banques de données (fichiers pour clients, routages, possibilités de transport, gestion du personnel) sont exécutés à l'aide du programme IMS d'IBM, alors qu'un programme spécial vient à bout de toutes les tâches de la distribution par traitement en temps réel avec accès multiple. A cet effet, toutes les données relatives à la livraison et aux clients sont mémorisées sur les disques magnétiques de façon à pouvoir assurer la distribution aux points de vente plusieurs fois par jour (journaux du matin, journaux du soir, périodiques) soit par des routages normaux, soit par des routages spéciaux (en cas de grève des chemins de fer, de la poste ou des avions).

L'actualisation des instructions de livraison suppose l'application de 50 000 à 100 000 modifications de service par jour, l'exécution des décisions commerciales des éditeurs, le calcul des tirages avec la sortie subséquente des documents d'expédition nécessaires et

Figure 5: Terminal programmable IBM 3735, . . .

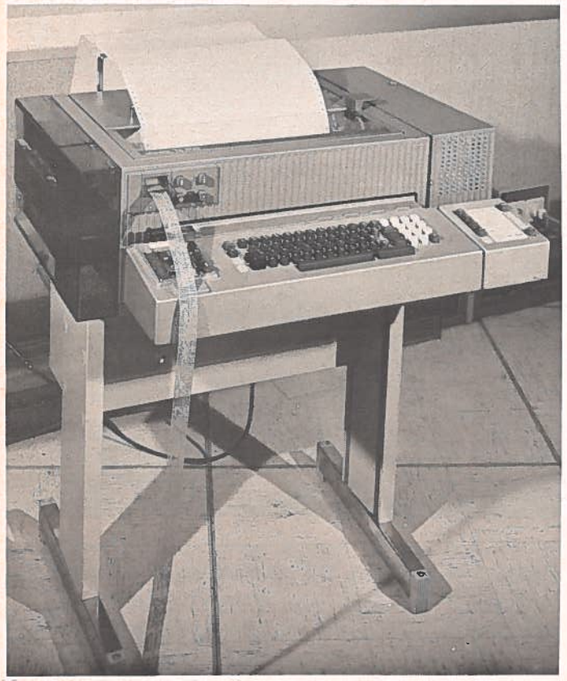


Figure 6: . . . terminal Olivetti TC 300, . . .

la préparation journalière de 1,5 million de lignes de factures.

Tous les ordres — qu'il s'agisse d'un changement de service, d'un calcul majorant les services dans les villes avec club de football ou d'instructions pour la préparation des expéditions — sont entrées à l'aide des terminaux. Dans le centre d'informatique même, ce sont surtout des terminaux à écran IBM 2260 complétés et remplacés par des terminaux IBM 3270.

Figure 7: . . . terminal Sagem . . .

Télétraitement intégré des données

Il est dans l'intérêt du système de distribution que les grossistes locaux puissent effectuer la gestion de leurs points de vente en se servant des ordinateurs centraux pour le traitement en temps réel. Deux genres d'utilisation sont le «télétraitement intégré des données» et le «traitement distribué des données». Chaque grossiste est responsable de la distribution dans sa ville et, parfois, dans un certain nombre de petites communes voisines. Quelques-uns n'ont que leur magasin de vente et trois ou quatre points de vente annexes. Ceux qui travaillent avec le télétraitement des données doivent servir pour le moins 30 points de vente, alors que ces derniers s'élèvent à plus de 1000 dans le cas des grandes agences locales de la Librairie Hachette (pour des villes comme Lyon, Marseille, Bordeaux, Toulouse et leurs environs).

Dans le cas du télétraitement intégré, le grossiste dispose — d'une part — d'emplacements dans les mémoires centrales afin d'y pouvoir loger des informations sur ses points de vente et sur tous les services de chacun d'eux pour chaque titre et — d'autre part — d'un terminal correspondant avec lequel il entre en contact avec les ordinateurs centraux par l'intermédiaire d'une ligne spéciale ou d'un réseau à commutation. A partir de son terminal, le grossiste introduit plusieurs fois par jour les ordres de modification de ses clients, corrige les quantités à livrer en fonction des nombres d'invendus, installe les nouveaux titres et les nouveaux clients, etc. Ce faisant, il est entièrement responsable vis-à-vis de sa clientèle. Mais il peut également utiliser le système pour le traitement de titres locaux ou régionaux non diffusés par les NMPP. Par ailleurs, son terminal l'avise de tous les nouveaux titres et des quantités prévues pour sa ville, des décisions commerciales des éditeurs conditionnées par le calendrier (vacances) ou du contenu de la prochaine édition. Il reçoit chaque soir une liste des titres et des quantités prévus pour l'expédition. Avec les envois de journaux et de périodiques, les NMPP lui fournissent automatiquement tous les documents nécessaires pour la répartition des publications à ses clients, les factures journalières et tous les autres documents utiles. La facturation s'opère chaque semaine après l'introduction des nombres d'invendus par le terminal. Prochainement, les NMPP lui livreront des analyses statistiques pour chaque titre.

Quatre types de terminaux sont actuellement mis en oeuvre. Le terminal programmable IBM 3735 avec

mémoire à disque incorporée (*figure 5*) fonctionne dans les 20 villes les plus importantes (plus de 150 vendeurs); sa liaison avec le centre s'effectue par l'intermédiaire d'un réseau spécial P et T (2400 Baud). Le terminal Olivetti TE 300 (*figure 6*) est un téléscripteur avec entrée et sortie à bande perforée; il relie les villes moyennes (50 à 150 vendeurs) aux NMPP soit par des lignes télégraphiques spéciales (en banlieue parisienne), soit par les lignes de télex à 200 Baud (en province). Le téléscripteur standard Sagem (*figure 7*) et le réseau de télex à 50 Baud sont expérimentés dans les villes plus petites (moins de 50 vendeurs). Enfin, le terminal à écran IBM 3275 avec imprimante associée (*figure 8*) fait l'objet d'essais dans la région parisienne. Grâce à un réseau spécial P et T, il devrait permettre le travail conventionnel — à un prix supportable — pour le moins dans les villes les plus importantes de la province.

Traitement distribué des données

Pour diverses raisons, certains grossistes désirent utiliser leurs propres petits ordinateurs. Avec plusieurs fabricants, les NMPP préparent présentement un programme standard afin de permettre les applications suivantes dès l'automne 1976: d'une part, la gestion locale de leurs points de vente et, d'autre part, la communication dans les deux sens avec les ordinateurs

Figure 8: . . . et terminal IBM 3275, tels que les utilisent les grossistes locaux pour la gestion de leurs points de vente par télétraitement.

centraux. Ces grossistes seront alors en mesure de transmettre leurs données d'actualisation et de recevoir les informations qui leur sont destinées à l'aide d'une

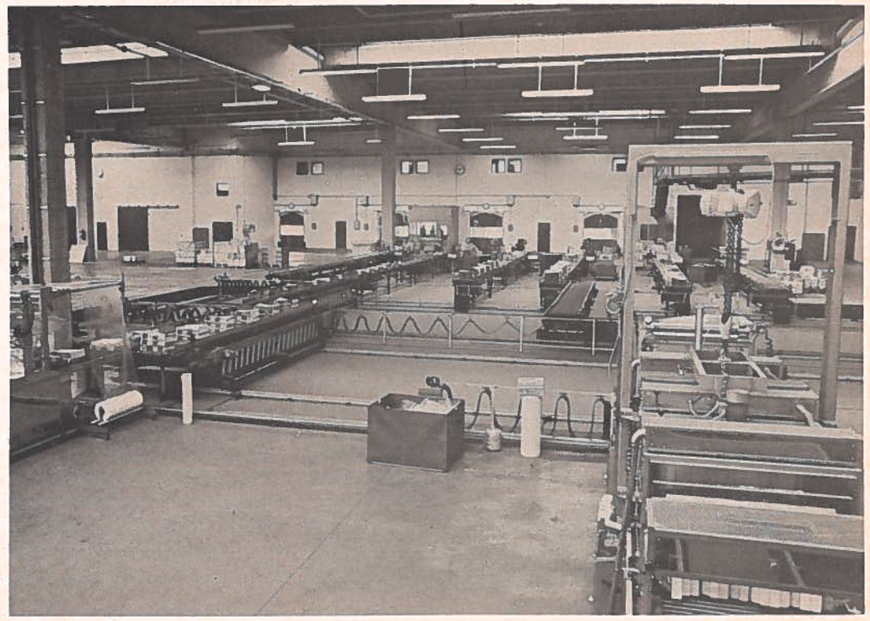


Figure 9: Vue de la salle d'expédition des NMPP à Rungis (à 10 km au sud de Paris). On y voit le système de regroupement et d'emballage.

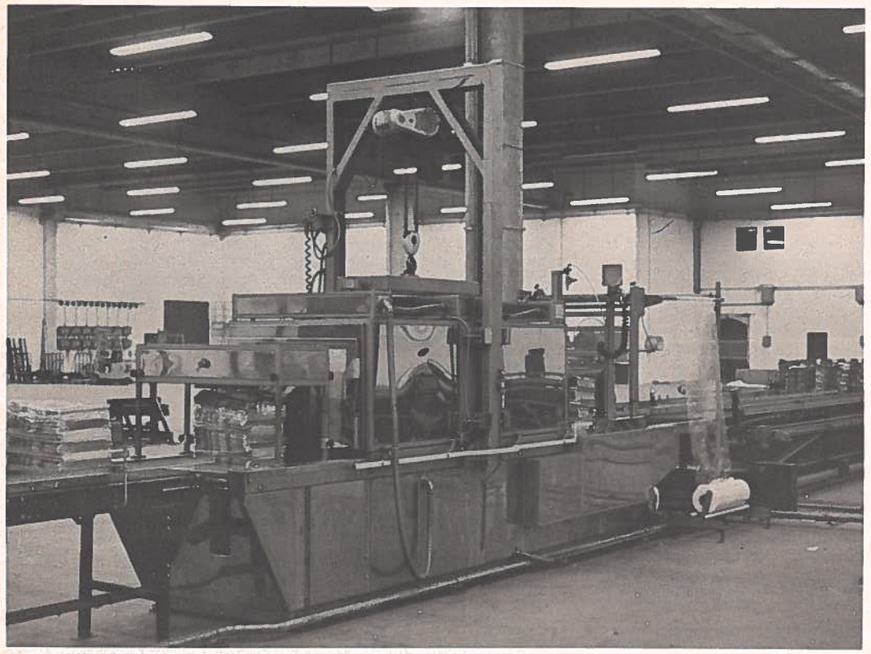


Figure 10: Les piles de journaux ou de périodiques formées sont emballées sous feuille thermorétractable . . .

mémoire tampon (file d'attente). De plus, les NMPP ont également mis en place un téléscripteur chez une quarantaine de grossistes — cela chez les plus importants parmi ceux qui ne bénéficient pas encore du télétraitement intégré ou dont les ordinateurs ne s'avèrent pas compatibles avec les installations centrales d'informatique. A la place des opérations de travail automatiques (telles qu'on peut les réaliser dans le cas des matériels compatibles), ces grossistes doivent utiliser des procédures manuelles, mais ils disposent cependant des mêmes possibilités globales.

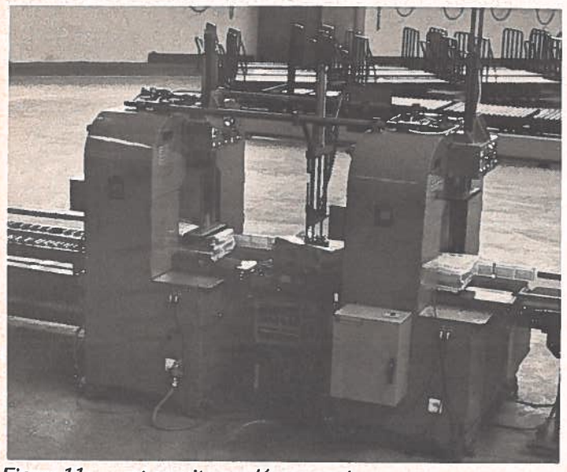


Figure 11: . . . et ensuite cerclées en croix.

L'expédition automatisée

De 1960 à 1962, nous avons construit deux grandes salles d'expédition aux limites sud et nord de Paris avec une surface totale d'environ 25 000 m². Reliées au chemin de fer pour l'expédition de wagons complets de publications (jusqu'à 140 par jour), elles permettaient l'utilisation de moyens de manutention modernes (palettes, chariots à fourche, etc.). Mais, dans cette première étape de modernisation, les principales opérations de comptage, d'emballage, etc. restaient manuelles. A partir de 1970, nous avons commencé d'étudier les possibilités de mécanisation de l'expédition. Et, en 1972, nous nous sommes décidés pour cette seconde étape afin, d'une part, de réduire les frais de personnel et, d'autre part, de rendre le travail plus attractif. Sur la base de cette décision, nous avons entrepris les travaux suivants: en 1975, détermination des méthodes de traitement et des équipements à acheter; en 1974 et début 1975, expérimentation des matériels choisis dans un centre pilote de 3000 m²; en 1975 (encore), construction du premier centre d'expédition automatisé.

Implanté à Rungis (à 10 km de Paris) dans un bâtiment où nous occupons quelque 16 000 m² de surface de plancher — dont une salle d'expédition de 12 000 m² —, ce centre bénéficie d'une bonne desserte routière (une autoroute et deux routes nationales) et d'un raccordement direct aux voies de chemin de fer. Depuis le 9 février 1976, nous y traitons les envois à 980 grossistes locaux servis par chemin de fer dans le Sud-Ouest de la France ou par camions de 3 à 6 t dans la banlieue sud de Paris. Chaque jour, le volume total atteint environ 900 000 exemplaires et un poids de 150 t. Les expéditions seront quasiment doublées au cours du premier trimestre 1977 lorsque s'y ajouteront les 850 grossistes locaux du Sud-Est de la France. Le nombre de titres à traiter journellement varie de 60 à plus de 150. Le plus grande partie arrive entre 7.00 et 17.00 h. Deux trains spéciaux pour Poitiers/Bordeaux et Limoges/Toulouse partent vers 19.00 h.

Les livraisons sont réparties en trois catégories. Dans la première, les *grosses quantités* traitées sur palettes, le volume total représente 80 titres (5 à 10 par jour), soit environ 40% du tonnage. L'expédition se fait à 27 très gros clients. Une palette contient le plus souvent deux ou trois titres. Les palettes sont emballées sous une housse en matière plastique thermorétractable. Encadrées par des convoyeurs à rouleaux entraînés, elles passent ensuite dans un tunnel de rétrécissement. Les *quantités moyennes* correspondent également à environ 40% du tonnage total. Elles sont livrées en paquets complets par les imprimeurs ou les brocheurs et traitées automatiquement chez nous. Par *petites quantités* — soit environ 20% du tonnage —, il faut entendre les volumes inférieurs à un paquet complet. Leur traitement exige forcément les systèmes les plus complexes et la plus grande partie du personnel. L'expédition des trois catégories repose sur une rigoureuse préparation par les ordinateurs. Elle s'opère dans la nuit précédant les livraisons et tient compte des nombres d'exemplaires pour chaque titre, de la composition des paquets livrés par les imprimeurs et des routages pour les clients.

Trois secteurs de traitement

A leur arrivée, les produits sont répartis entre trois secteurs de traitement. Dans le premier, nous préparons les palettes; dans le second, nous regroupons des colis constitués par quelques paquets d'un même titre et destinés à un seul et même client; dans le troisième, nous traitons les envois mixtes.

Le secteur 2 a pour tâche de grouper des paquets

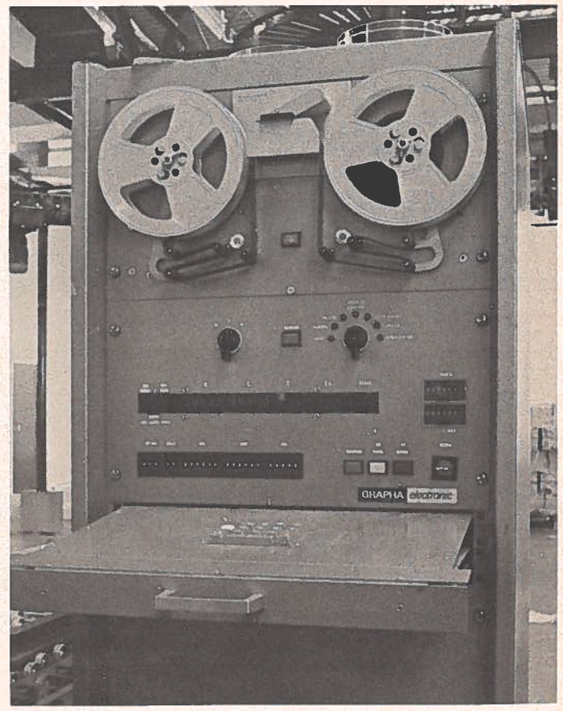


Figure 12: Chacune des quatre lignes de comptage des appoints se compose d'un convoyeur, d'une sortie à paquets et d'une imprimante à étiquettes. Sa commande s'effectue à l'aide d'une unité électronique avec lecteur de bandes perforées.

formés par les imprimeurs pour en faire des colis d'un poids moyen de 20 à 25 kg et, ensuite, de les protéger en cours de transport par un autre emballage. Autrefois, cette opération s'effectuait avec des sacs de jute munis d'une étiquette à la gueule. Le nouveau système (*figure 9*) comprend six lignes de préparation (trois à cinq étant en service, et une servant de réserve) et deux lignes d'emballage (parfois une seule utilisée). Chaque ligne de préparation se compose d'un poste de travail et de deux convoyeurs à tapis. Font partie du poste de travail: une table élévatrice pour la palette, un pupitre de commande et un transporteur à bande pour la dépose des paquets. Le nombre de paquets figure sur une étiquette livrée par l'ordinateur et placée sur les paquets. Les opérations de travail subséquentes sont automatiques. Les deux convoyeurs à tapis reprennent successivement les colis formés par les paquets et accumulés par «rafales» de douze pièces (nombre optimal pour le rendement du système). Un autre tapis «transbordeur» vient prendre latéralement la rafale

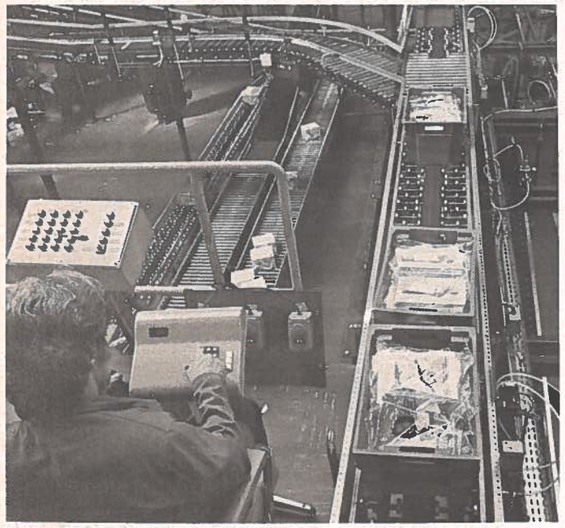


Figure 13: A son entrée dans le système de répartition, chaque bac contenant des appoints reçoit un signal numérique d'indexation qui le dirige vers l'un des postes de triage par client.

prête et l'introduit dans une machine à emballer sous feuille thermorétractable (*figure 10*; épaisseur de la feuille: 80 µm). Après passage dans le tunnel de rétrécissement, les colis sont cerclés sur une ficeleuse tandem par une bande en matière plastique (cinq possibilités de cerclage: simple, dans un sens ou dans l'autre, en croix, etc.). Un code transmis par le système avec chaque rafale fixe le genre de cerclage. Les colis cerclés sont évacués par un convoyeur à rouleaux

Figure 14: Poste de triage pour le groupement des appoints (titres) isolés par client.

entraînés. Chaque ligne d'emballage a un rendement nominal de 25 colis/min, mais le débit effectif se situe à environ 20 colis/min.

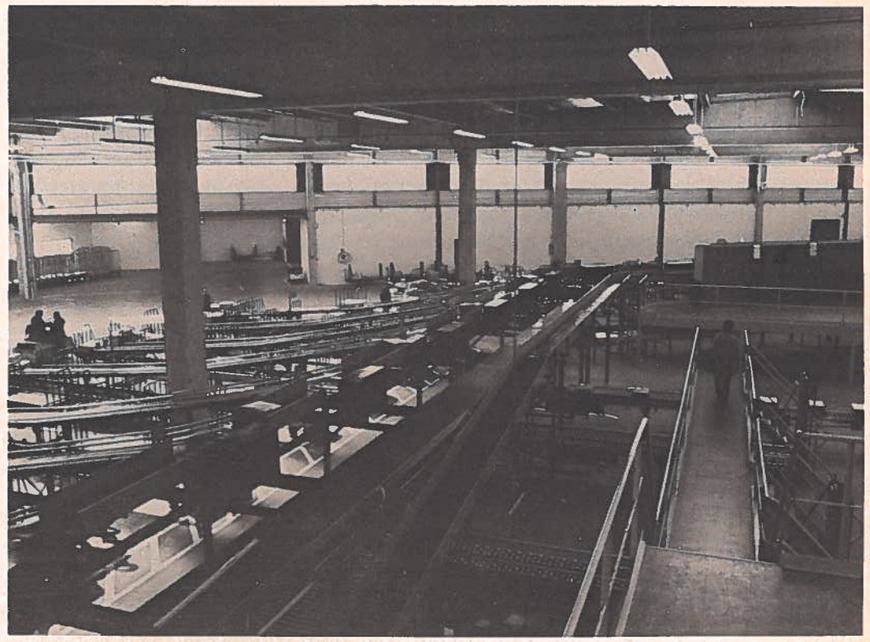
Dans le secteur 3, les «appoints» (paquets de tête) et les petits envois de réassortiment sont préparés, regroupés par client, emballés dans des cartons et acheminés vers le triage final. L'appoint moyen contient onze exemplaires. Le nombre des exemplaires emballés dans les appoints pour nos 980 clients actuellement servis peut varier de quelques dizaines à plus de 30 000 par titre. Comme la mécanisation de toutes les opérations de travail n'entrait pas en ligne de compte dans ce secteur, nous nous sommes efforcés

- d'automatiser le comptage des titres qui en valent la peine,
- de mécaniser au maximum le transport des produits entre les différents stades de la préparation et
- de faciliter les tâches manuelles restantes par un environnement et des méthodes adaptés.

La formation des appoints (phase de travail 1) s'opère mécaniquement (comptage automatique et identification par client) pour autant que le titre le permette en ce qui regarde le nombre d'exemplaires et lorsque son format et son épaisseur s'avèrent compatibles avec les machines. Dans le cas de tous les autres titres (environ 30% des exemplaires isolés), le nombre d'exemplaires nécessaire est simplement mis dans un bac que le système achemine ensuite vers la zone de triage. Quatre lignes de comptage servent à la formation des appoints mécanisés. Chacune comprend un margeur à exemplaires, une sortie à paquets avec bande transporteuse sise en aval, une imprimante de documents pour la sortie de l'étiquette porte-adresse (dépose mécanique sur l'appoint) et une emballeuse (mise de l'appoint et de son étiquette dans une pochette en matière plastique de 30 µm d'épaisseur). Une unité électronique (*figure 12*) commande l'ensemble à l'aide d'une bande perforée produite à chaque parution par les ordinateurs de gestion. En bout de ligne, les appoints sortis dans l'ordre voulu sont placés dans des bacs pour transfert dans la zone de triage.

Le triage par client (phase de travail 2) est pris en charge par 20 groupes (postes de travail) qui peuvent traiter chacun jusqu'à 80 clients. Chaque poste de triage (*figure 14*) comporte non seulement deux séries opposées de 40 cases, mais également des aides à la manutention tels que tables à billes, convoyeurs à rouleaux libres devant les cases, etc. Un système de convoyeurs à tapis montés à une hauteur de 3 m

Figure 15: Système de convoyeurs dans la zone de triage final avec goulottes de sortie (à gauche).



alimente les différents postes. Par l'intermédiaire d'un clavier, on attribue des numéros de groupe aux bacs contenant les appoints (*figure 13*). Puis le système amène les bacs au-dessus du poste de travail et — si nécessaire — les accumule sur un convoyeur d'attente. En cas de saturation d'un poste, les bacs sont soit recyclés sur une boucle du circuit (ils y reviennent après 4 min), soit stockés sur une nappe de 4 x 60 bacs (également utilisée pour le stockage des bacs vides). Les bacs acheminés vers les postes descendent un à un par un transporteur vertical dès que l'ouvrier a pris le bac précédent. Puis l'ouvrier saisit les appoints dans le bac (dans l'ordre des cases) et les place dans les cases des clients concernés. Chaque case est garnie d'un carton spécial dans lequel sont déposés les appoints. Une fois plein, le carton client (qui contient par exemple les appoints de 10 à 20 titres) reçoit un couvercle avec l'étiquette de routage du client. Les cartons pleins et les bacs vides sont alors transférés sur l'un des deux convoyeurs de ramassage qui desservent tous les postes de triage. Repérés par leur hauteur, les bacs vides retournent vers les lignes de comptage, alors que les cartons vont à l'emballage. Selon les besoins de la production, les cartons pleins sont aiguillés vers une, deux ou trois lignes d'emballage (phase de travail 3, fardelage sous film thermorétractable et, subséquemment, liage transversal avec bande en matière plastique). Ils passent ensuite par le triage final.

Tous les colis emballés dans les secteurs 2 et 3 arrivent dans le système de triage final. Ce dernier comprend un convoyeur à écailles dont l'axe mesure 120 m de longueur et qui circule à une hauteur maximale de 2,50 m, deux stations d'introduction où tous les colis acheminés sont munis d'un numéro de wagon ou de camion par frappe sur un clavier et 24 goulottes de triage où l'on fait passer les colis (*figure 15*). Une goulotte sert soit pour un gros véhicule, soit pour deux petits. Les colis triés sont repris sur des chariots pour chargement dans les wagons, les gros lots étant en outre palettisés.

La commande des processus

Elle se fait à trois niveaux. Les ordinateurs IBM 370/168 du centre d'informatique se chargent des travaux préparatoires d'ordonnancement et de l'édition des documents nécessaires (listes de distribution, étiquettes pour paquets complets, bandes perforées pour la confection des appoints). Deux calculatrices industrielles Philips P 855 (chacune avec mémoire à ferrites de 16 000 mots à 16 bits) commandent le secteur des paquets complets et les lignes de préparation et d'emballage. Au troisième niveau, les unités électroni-

ques de contrôle des lignes de comptage pour appoints intègrent chacune un microprocesseur Intel 8008.

Les fabricants

Les équipements proviennent de divers fabricants, à savoir Rapistan pour tous les systèmes de manutention continue (sauf le transporteur à écailles construit par Teleflex), Müller-Martini (Grapha Electronic) pour les lignes de comptage des appoints, Ouest-Conditionnement pour les machines à emballer sous feuille thermorétractable, SAT pour le tunnel de rétrécissement (palettes) et Ampag pour les machines à cercler sous liens plastiques.

Investissements, effectifs, rentabilité

Les investissements dans le centre d'expédition se sont élevés à environ 20 millions de FF pour les systèmes automatisés, auxquels s'ajoutèrent plus de 5 millions de FF pour des équipements divers (groupe électrique, compresseurs, etc.). Le centre emploie présentement 80 ouvriers, 10 techniciens d'entretien et 10 cadres. Avant l'automatisation, il comptait 120 ouvriers. La pleine rentabilité sera atteinte l'an prochain lorsque nous devrons traiter le double du volume actuel (par travail en deux équipes de 6.00 à 22.00 h). Alors que la capacité de traitement de nos anciens équipements était déjà pratiquement épuisée en 1973 (avant le début de la récession), nous disposons maintenant d'une importante capacité supplémentaire pour les deux équipes. Nous projetons de réaliser un second centre — au nord de Paris — vers les années 1979/1980.

Des nouveaux locaux pour TFL

Au cours de l'été, le laboratoire de recherches commun (TFL) des quatre fabricants de papier journal suédois Holmens Bruk, Hylte Bruks, Stora Kopparberg et Svenska Cellulosa a emménagé dans de nouveaux locaux — situés à Danderyd — qui lui permettront un plus large éventail d'activités. Par ailleurs, les quatre entreprises ont donné au TFL la forme d'une société anonyme. Depuis 1961, le directeur du TFL est le Dr L. O. Larsson (voir entre autres «techniques de presse» de mai 1975, page 20).

Tendance à la hausse de la réutilisation des vieux papiers

Avec une part de vieux papiers atteignant presque 44% de toutes les matières premières utilisées en 1974, l'industrie du papier et du carton de la République fédérale d'Allemagne occupe le deuxième rang (le premier d'après la quantité effective) dans la comparaison européenne. Le *tableau* fait ressortir le fait suivant: pendant les 25 dernières années, non seulement la quantité de vieux papiers réutilisés a fait l'objet d'une augmentation, mais également (et presque sans exception) sa part dans les matières premières. De même, la part jusqu'ici minime des vieux papiers suédois doit probablement s'accroître dans les temps à venir (voir «techniques de presse» d'avril 1976, page 37).

Dans la seule RFA, des frais d'environ 280 millions de DM furent épargnés en 1974 à la communauté pour l'élimination des déchets. A cela s'ajoute une moins forte consommation d'énergie (160 à 250 kW/t contre 650 kW/t pour la pâte au sulfite et 800 à 1500 kW/t pour les différentes sortes de pâte mécanique). Mais, comme on le sait, la réutilisation se voit fixer des limites techniques et économiques en ce qui regarde le triage, la préparation et la qualité du produit. Pour cette raison, les projets mis en route par le gouvernement fédéral de Bonn comprennent le développement et l'expérimentation de procédés techniques pour la séparation des déchets de papier d'avec les ordures

	1960		1965		1970		1974	
	1000 t	%	1000 t	%	1000 t	%	1000 t	%
RFA	1319	38,4	1823	43,0	2511	45,6	2854	43,7
Grande-Bretagne	1382	33,9	1688	37,2	1990	40,6	2085	45,8
France	762	29,1	975	30,8	1369	33,1	1823	36,0
Italie	307	20,9	534	24,2	1112	29,3	1410	33,6
Suède	175	8,1	202	6,5	279	6,4	346	6,3
Finlande	77	3,9	137	4,3	200	4,7	174	3,2

La réutilisation de vieux papiers (quantité et part en % dans les matières premières) dans le cas de la production de papier et de carton des principaux pays européens.

ménagères, des études générales sur le traitement subséquent des vieux papiers et des études modèles pour le ramassage séparé des vieux papiers. En faisant valoir le haut taux d'utilisation en RFA qui prouve les avantages des initiatives de l'économie privée, Bonn refuse l'intervention de l'Etat dans le marché des vieux papiers telle que la recommande une étude de la CEE.

Détails des «Cambridge News» sur la litho directe

Le journal «Cambridge News» — dont les plans pour la conversion à la litho directe ont brièvement fait l'objet d'une communication dans «techniques de presse» de juillet/août 1976, page 87) — vient de nous donner d'autres détails. La rotative typo Hoe-Crabtree existante comprend 10 groupes d'impression et son âge varie de 23 (plus anciens groupes) à 10 ans (plus récents groupes). Il n'y a pas d'éléments couleur (l'impression des couleurs d'appoint et les travaux bichromes en registre s'effectuent avec les groupes d'impression normaux). On prévoit de procéder à la conversion en février 1977. Les équipements et matériaux suivants seront mis en oeuvre: des dispositifs de mouillage Dahlgren, une solution de mouillage probablement alcaline avec 5% d'alcool et un pH entre 8 et 10, des blanchets typo normaux (mais neufs), une encre typo Usher-Walker avec densité élevée et formation réduite de voltige, des selles Croda et du papier journal de divers fabricants. On s'occupe actuellement du cuivrage des cylindres acier dans les encrages.

A Cambridge, le procédé litho directe n'est pas considéré comme une solution transitoire, mais bien comme un procédé d'impression autonome qui permet le passage à la photocomposition. Entre-temps, un deuxième journal britannique — le «East Anglian Daily Times» — a fait part de son intérêt pour la litho directe.

L'utilisation subséquente de nouvelles et d'informations

par les entreprises de journaux a fait l'objet d'une enquête effectuée aux Etats-Unis par la Wickford Development Company. Presque 75% de tous les journaux avec tirages dépassant 250 000 exemplaires et près de 60% des journaux dans la gamme de tirages entre 100 000 et 250 000 exemplaires répondirent à l'enquête. Par ailleurs, des journaux représentatifs avec des tirages très élevés et des tirages inférieurs à 100 000 exemplaires furent également questionnés. Les résultats de l'enquête montrent que les possibilités d'utilisation subséquente de nouvelles, d'informations et de données propres sont exploitées ou envisagées par un nombre étonnamment grand d'entreprises. De la sorte, elles se créent des revenus additionnels, d'une part, et améliorent également leur mode de travail, d'autre part. 53% des entreprises questionnées vendent des données démographiques sur leurs abonnés, 49% réunissent des nouvelles d'agences de presse pour en faire des services d'information spéciaux, 37% publient des tirages spéciaux des séries d'articles, etc. paraissant dans le journal et 27% produisent des éditions sur microfilms de leur journal. En outre, 44% projettent l'établissement d'archives et 25% l'implantation d'une banque de données sur la base d'installations d'informatiques (respectivement 5% et 21% se servent déjà de telles installations), 23% prévoient la construction d'imprimeries satellites (locales ou régionales), 19% l'introduction de (nouvelles) éditions locales ou régionales de leur journal, 13% la livraison d'informations digitalisées à des tiers et 11% la mise sur pied de services d'information «sur demande».

Le rapport sur cette enquête est livrable tant sous forme de version abrégée (25 dollars) que sous forme de version détaillée (175 dollars) par la Wickford Development Company Limited (65 High Park Avenue, Toronto, Ontario M6P 2R7, Canada).

Livre d'adresses Polygraph, 1976/77 (RFA, Berlin-Ouest, Autriche, Suisse)

La 38e édition du «Livre d'adresses Polygraph 1976/77 pour l'industrie graphique» contient des données relatives à 2923 ateliers de composition et ateliers de reproduction (partie 1), 12 820 imprimeries (partie 2), 3934 ateliers de reliure (partie 3), 6034 entreprises spécialisées dans la composition, la reproduction, l'impression et le traitement ultérieur (partie 4) et à 3343 fabricants et fournisseurs pour l'industrie graphique (partie 6). Outre l'adresse postale, on y trouve les numéros de téléphone et de télex, les noms des propriétaires, des directeurs gérants et des associés, de même que le nombre de collaborateurs et informations sur les équipements techniques. Les données sont classées d'après les pays (République fédérale d'Allemagne, Berlin Ouest, Autriche, Suisse) et, à l'intérieur de ceux-ci, suivant l'ordre alphabétique des localités et des noms. Un registre alphabétique des firmes précède les parties 1 à 4; il donne à chaque fois des renseignements sur la partie et le groupe spécialisé. La partie 5 renferme une vue d'ensemble mondiale sur les associations et les organisations, les écoles et les établissements d'enseignement, les instituts de recherches, les publications spécialisées, les foires et les expositions, ainsi que sur les ingénieurs-conseils de l'industrie graphique et de l'industrie de transformation du papier. Une liste des sources d'approvisionnement et une liste des marques et des mots clés figurent dans la partie 7. La 39e édition paraîtra en 1978.

Polygraph Adressbuch der Druckindustrie 1976-77. Maison d'édition Polygraph S.à.r.l., Schaumainkai 85, D-6000 Francfort-sur-le Main. 1200 pages format DIN A4, registre à encoches, 86 DM.

Les Milwaukee Newspapers utilisent un système de rédaction Hendrix

A fin avril de cette année, conjointement avec le passage intégral à la photocomposition, les Milwaukee Newspapers — le «Journal» paraissant le soir et le dimanche (338 000 exemplaires) et le journal du matin «Sentinel» (167 000) — à Milwaukee (Wisconsin, USA) ont mis en service un système Hendrix pour la saisie et le traitement des textes. Ce système se compose de quatre systèmes partiels Hendrix 3400 — reliés entre eux — avec une contenance totale de la mémoire externe s'élevant à 32 MB. Deux systèmes partiels travaillent à chaque fois pour l'un des deux journaux, mais sans qu'ils aient accès aux mémoires des autres. Les lignes des agences de presse arrivent directement dans la mémoire du système. Le «Journal» dispose de 62 terminaux à écran, la «Sentinel» de 42. Quatre autres servent à la surveillance du système dans la salle des ordinateurs. L'entier système est raccordé à un système d'ordinateurs de composition de General Automation qui commande directement trois photocomposeuses APS-4.

Harris complète son offre dans le domaine du traitement des textes

Deux nouveaux systèmes, deux nouveaux terminaux à écran et deux nouveaux programmes: tels sont les principaux nouveaux-nés dans la famille des systèmes de saisie et de traitement des textes Harris 2500. Aux systèmes 2520 et 2550 — qui fonctionnent par exemple aux journaux «Der Bund» à Berne (CH) et «Brabants Nieuwsblad» à Roosendaal (NL) ou dont l'installation doit se faire chez Ringier («Blick») à Zofingue (CH) — s'ajoutent désormais les systèmes 2560 et 2570. Les terminaux à écran 1520 et 1700 contribuent à une augmentation du rendement et de la précision à la rédaction, dans le département annonces et dans l'atelier de composition. Le programme HNS/1 commande les petits systèmes 2520 et 2550, le programme HNS/2 les deux grands.

Le système 2520 convient à des journaux dans la plage de tirages entre 10 000 et 50 000 exemplaires (15 collaborateurs à la rédaction, trois pages d'annonces classées par jour). Une configuration typique avec quatre appareils à écran, une unité centrale, une mémoire à disque magnétique pour 4,8 MB et des appareils périphériques coûte moins de 120 000 £ (gamme de prix: 75 000 à plus de 150 000 £). — Quant au système 2550, il est surtout en service aux journaux avec tirages entre 25 000 et 100 000 exemplaires. Des caractéristiques typiques sont 50 collaborateurs à la rédaction, jusqu'à six lignes d'agences de presse directement raccordées et jusqu'à 20 pages d'annonces classées par jour. Une configuration avec 16 terminaux à écran du type 1700 et 8 du type 1520, une unité centrale, une mémoire à disques magnétiques pour 66 MB, des appareils périphériques et un programme HNS/1 revient à environ 280 000 £ (gamme de prix: 135 000 à 600 000 £).

Le nouveau système 2560 doit couvrir la plage de tirages entre 50 000 et 200 000 exemplaires (plus de 250 collaborateurs à la rédaction, quatre rédactions locales, huit lignes d'agence de presse en raccordement direct, 25 pages d'annonces classées par jour). Tout comme le système 2570, il fonctionne avec deux unités centrales. Afin d'avoir une entière sécurité contre les pannes, on peut également doubler les unités de commande et les mémoires à disque magnétique. L'installation du premier système européen doit s'effectuer au début de 1977 à l'entreprise Rotabest BV à Best, NL (voir «techniques de presse» de juillet/août 1976, page 82). Une configuration typique avec 72 terminaux à écran (36 du type 1700 et 36 du type 1520), deux unités centrales, deux mémoires à disques magnétiques (chacune pour 132 MB) et un grand nombre d'appareils périphériques et d'appareils de commande coûte environ 700 000 £ (gamme de prix: 500 000 à plus de 1 million de £).

C'est pour les journaux avec tirages de plus de 100 000 exemplaires qu'est conçu le système 2570. Autour de l'unité centrale et de la mémoire à disques magnétiques toutes deux doublées), on peut grouper jusqu'à huit unités de commande pour appareils périphériques (imprimantes de documents, machines à lire, photocomposeuses, etc.) et jusqu'à 384 terminaux à écran. Les premiers systèmes de ce type seront montés au milieu de l'année 1977 (entre autres au «New York Times»). Un système de grandeur moyenne (unité centrale double et mémoire double, trois unités de commande, environ 150 terminaux à écran et au moins 50 autres appareils périphériques) — qui pourrait être mise en service dans une entreprise de journaux avec tirage d'environ 400 000 exemplaires — revient à environ 1,2 million de £ (gamme de prix: environ 700 000 à plus de 2 millions de £).

Le nouveau terminal à écran 1520 a une mémoire tampon pour 960 caractères et peut fonctionner en liaison avec les quatre systèmes Harris 2500. Son écran (diagonale: 25 cm) permet la visualisation de 12 lignes

Quelques caractéristiques des quatre systèmes Harris pour la saisie et le traitement des textes dans les entreprises de journaux.

	2520	2550	2560	2570
Nombres maximaux pour				
terminaux à écran	24	48	96	384
mémoires à disque magnétique	3	4	4	4
contenance (MB)	132	132	264	264
lignes d'agences de presse et rédactions locales	8	12	16	16+
appareils périphériques	32	64	128	128+
Agrandissement possible jusqu'à	2550	2560	2570	–
Réserve obtenue par				
doublement de l'unité centrale	–	–	standard	standard
doublement des unités de commande	possible	possible	possible	possible
Redémarrage après panne de courant	standard	standard	standard	standard

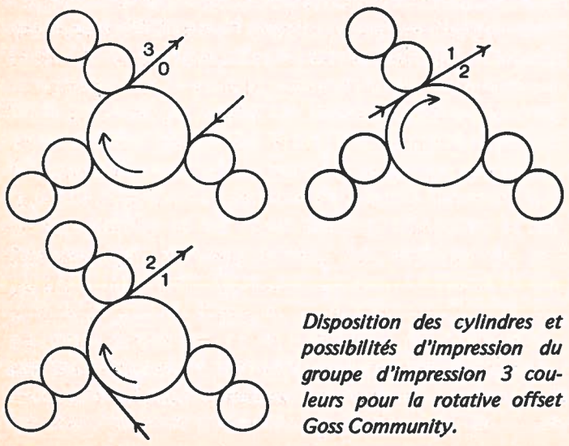
à 80 caractèrs chacune. Le clavier comprend une partie normale avec 56 touches, 8 touches de fonctions programmables (pour la mémorisation, le rappel, l'indexation et la rédaction) et 7 touches pour la commande de la marque de position (cette dernière est transparente et ne clignote pas). Font partie des nouveautés — outre les touches de fonctions programmables —: des possibilités élargies de rédaction et d'effacement, une visualisation de caractères accrue (14 points, avec empattements, 9 x 12 segments de ligne, 112 caractères différents), une glace antireflet devant l'écran et une disposition améliorée du clavier. Les premières livraisons en Europe se feront paraît-il en 1977. Le prix unitaire se monte à 4250 £.

Plus d'une douzaine de nouveautés caractérisent le terminal à écran 1700 qui convient pareillement aux quatre systèmes. Son écran (diagonale: 30 cm) peut visualiser soit 27 lignes à 72 = 1974 caractères (sur une colonne), soit 54 lignes à 35 = 1890 caractères (sur deux colonnes). De cette manière, il est possible de comparer et de combiner deux informations. Les modifications effectuées à une information originale aux différents stades du déroulement des opérations de travail peuvent être rendues visibles par des biffages, des soulignements, une visualisation foncée sur fond clair, etc. L'opérateur peut programmer jusqu'à 32 fonctions ou codes, puis les rappeler à l'aide d'une seule frappe. Pour la recherche de blocs de textes contenant 32 caractères et pour leur remplacement automatique, une seule frappe suffit également. Le continuel mouvement ascendant et descendant de l'affichage s'opère à la vitesse de 10 lignes/s lorsqu'on presse sur une touche. On peut visualiser en tout 128 signes standards et 64 signes spéciaux (choix par l'utilisateur) à l'aide d'une matrice de 11 x 15 points (hauteur d'oeil: 14 points). Le clavier comporte 56 touches normales, 8 touches de fonctions programmables en quatre positions de commutation et, à chaque fois, des touches doubles pour la commande de la marque de position (dans les deux moitiés de l'écran). Le fabricant indique un prix unitaire de 5300 £. La livraison du terminal doit commencer en janvier 1977.

Les différents composants modulaires des paquets de programmes HNS/1 et HNS/2 permettent la saisie et le traitement d'annonces classées et d'annonces maquettisées, la réception et la rédaction de nouvelles d'agences de presse, le raccordement à des machines à lire, la commande de photocomposeuses et l'exécution d'autres travaux (en tout plus de 25). Lors de l'utilisation du HNS/2, chaque reporter ou chaque rédacteur peut par exemple se servir de son terminal à écran pour l'établissement d'une banque de données personnelle.

Groupe d'impression 3 couleurs pour la Community de Goss

Pour sa rotative offset de simple largeur du type Community, MGD Graphic Systems a mis au point un groupe d'impression 3 couleurs qui peut imprimer une bande de papier soit en trois couleurs sur un des côtés, soit en une couleur sur un des côtés et en deux couleurs sur l'autre. Trois paires de cylindres (cylindres porte-plaques et cylindres porte-blanchets) sont disposés autour d'un cylindre d'impression central (voir la *figure*). Chose inusitée, le cylindre d'impression comporte un blanchet offset. De ce fait, il est possible d'imprimer également la bande à l'aide de ce cylindre en plus de l'impression avec les cylindres porte-blanchets (offset double). Cette possibilité élargit la gamme d'applications par rapport aux groupes d'impression traditionnels — sans qu'il faille nécessairement renverser aussi le sens de marche des cylindres. D'autres caractéristiques — telles que les dispositifs de serrage des plaques et le graissage automatique — sont reprises du groupe standard Community. Jusqu'à ce jour, plus de 6000 groupes d'impression Community tournent dans le monde entier. Sur option, on peut les monter sur deux ou trois étages.



Disposition des cylindres et possibilités d'impression du groupe d'impression 3 couleurs pour la rotative offset Goss Community.

Système Tray-matic pour Dagens Nyheters AB

C'est à 1,8 million de dollars que se monte la commande que l'entreprise Dagens Nyheters AB à Stockholm (un membre de l'IFRA) vient de passer à la firme Cutler-Hammer à Denver (Colorado, USA) pour un système automatisé de distribution de paquets de journaux Tray-matic. Son installation doit se faire dans un nouveau bâtiment de production (Ralambsvägen 17, Stockholm). La mise en service pour la pleine production est prévue pour le printemps 1978.

Dagens Nyheters AB produit le journal du matin «Dagens Nyheter» (tirages: 452 000 exemplaires les jours ouvrables, 549 000 le dimanche) et le journal du soir «Expressen» (respectivement 575 000 et 646 000). Le système Tray-matic assurera la liaison entre 18 ficeleuses dans la salle d'expédition et 22 positions pour camions de livraison à la rampe de chargement. Il comprend un dispositif de commande et une boucle de transport continuellement en mouvement (longueur: plus de 143 m) à laquelle sont suspendus 188 récipients en forme de bacs. Le système compte et identifie tous les paquets de journaux repris automatiquement, et il codifie les récipients de transport de façon à ce qu'ils soient déchargés lors du passage de la position d'arrivée. Toutes les positions de la rampe de chargement peuvent être alimentées depuis chacune des ficeleuses. Comme le système compte également les paquets éjectés, on obtient un travail précis. Si l'on ne peut charger un camion de livraison ou si l'on doit interrompre son chargement pour charger un autre, les paquets sont stockés provisoirement dans la boucle, puis éjectés ultérieurement à la position prévue conformément à la codification des bacs.

Le système Tray-matic a un débit maximal de 200 paquets/min. On peut le commander manuellement, semi-automatiquement et automatiquement. Un ordinateur double spécialement programmé et des terminaux à écran pour service en temps réel font partie du dispositif de commande. Avant le démarrage de la production, le département de diffusion peut préparer des listes d'expédition pour 999 routages (maximum) avec les nombres d'exemplaires nécessaires des éditions locales et régionales des deux journaux. Le système doit aider Dagens Nyheters AB à surmonter les problèmes soulevés par des tirages croissants, des délais d'expédition avancés, un plus grand nombre d'éditions et d'encarts, des trajets de livraison plus longs et des conditions de trafic plus défavorables. Finalement, il doit satisfaire également le désir relatif à des délais limites de remise retardés.

Dagens Nyheters AB sera le premier utilisateur européen d'un système Tray-matic. Des systèmes semblables ont été mis en service ces dernières années par des journaux américains de premier plan. Cutler-Hammer a reçu récemment une commande de l'entreprise Philadelphia Newspapers — l'éditrice du journal «Inquirer» paraissant le matin et le dimanche (respectivement 410 000 et 845 000) et du journal du soir «News» (241 000) — pour la livraison d'un système du même type.

Les Richmond Newspapers complètent leur système pour annonces classées

Les Richmond Newspapers (voir «techniques de presse» de mai 1974, page 17, et de février 1975, page 35) ont complété leur système pour annonces classées — basé jusqu'ici sur la lecture optique — en lui ajoutant 24 terminaux à écran pour la réception téléphonique des annonces. Ces terminaux sont reliés à un ordinateur IBM 360/50. Le nouveau mode de travail permet la détermination immédiate du prix exact de l'annonce, de même que le passage ultérieur à la facturation automatique. Toutes les annonces publiées restent mémorisées pendant 30 jours. En cas de demande pour une nouvelle parution, on peut donc les rappeler sur l'écran à des fins de contrôle et de modification éventuelle.

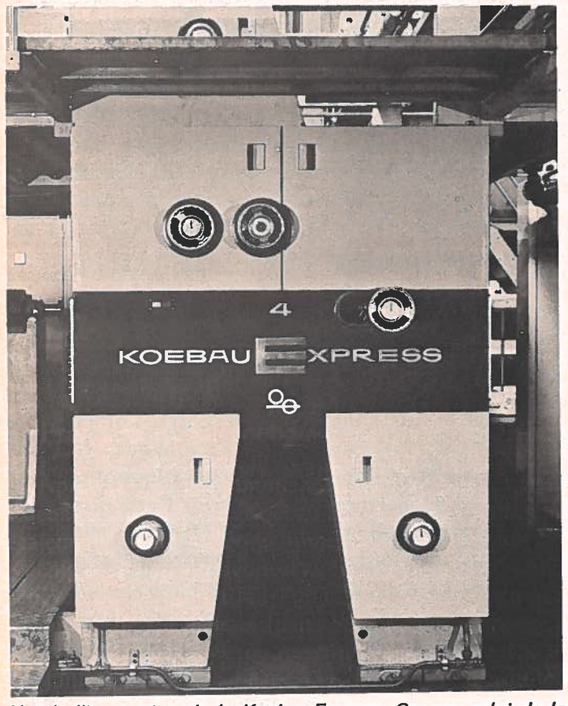
H. Berthold représente Harris en RFA et en RDA

Depuis le 1er juillet 1976, la Harris Composition Division est représentée en République fédérale d'Allemagne et en République démocratique allemande par la firme H. Berthold SA, à Berlin. Cette dernière a repris le personnel allemand de Harris et s'occupe maintenant de toutes les installations existantes et futures Harris dans le secteur de la photocomposition et des systèmes de rédaction. La continuité de la formation et du service vente est également assurée. Jusqu'à l'achèvement de toutes les mesures nécessaires, Harris-Intertype S.à.r.l. à Sprendlingen (D) continue d'exister. Berthold fait observer le complètement de son propre éventail de produits par les équipements Harris et la densité du réseau existant de service après-vente.

Première de la Koebau-Express à Wurzbourg

Après la Koebau-Commander (Types 1 et 2) et la Koebau-Compacta, la Koebau-Express fait désormais également partie du programme de rotatives offset de Koenig & Bauer. Au début d'août, la première machine achevée de ce type a fait l'objet d'une présentation à un public de spécialistes (dans «techniques de presse» d'avril 1975, page 39, de novembre 1975, page 43, et de juillet/août 1976, page 83, on trouve des notes relatives aux ventes enregistrées jusqu'à ce jour pour ce type de rotative).

La Koebau-Express est avant tout conçue pour des imprimeries de journaux qui doivent sortir des tirages moyens (30 000 à 80 000 exemplaires) et des produits comprenant normalement 32 à 48 pages (maximum: 64 pages) — donc pour des utilisateurs pour lesquels la Koebau-Commander s'avère trop grande et la Koebau-Compacta trop petite. Comme dans le cas de la Koebau-Commander, il s'agit d'une machine de double largeur. Sa vitesse de production peut atteindre 25 000 tours de cylindre/h. La Koebau-Express est livrable dans l'exécution parterre, avec ponts intermédiaire ou avec sous-structure, de même qu'avec les circonférences de cylindre suivants: 940 mm (pour le format berlinois), 1040 mm (pour le format rhénan), 1120 mm (pour le format nordique), 1156 mm (pour le format américain 22 ¾") et 1197 mm (pour le format américain 23 $^{9}/_{16}$"). Elle traite des laizes jusqu'à 1750 mm. D'autres formats exigent des prix plus élevés et des délais de livraison plus longs.



Unité d'impression de la Koebau-Express. Comme celui de la Koebau-Commander, son cylindre porte-plaques peut accepter quatre plaques dans la largeur et deux sur la circonférence. Son capotage contribue nettement à la diminution du bruit (même remarque dans le cas de la plieuse).

La rotative présentée est destinée à l'imprimerie Delo, à Ljubljana (Yougoslavie). Elle comporte deux porte-bobines (de MEG) avec changeurs automatiques, deux unités d'impression avec groupes couleur (verso) pour couleurs d'appoint et quadrichromies, deux paires de barres de retournement et une plieuse à mâchoires avec mécanisme de pliage pour le 3e pli. Cette machine permet diverses variantes de production, à savoir

- 32 pages (dont 16 en deux couleurs),
- 24 pages (dont 4 en quatre couleurs, 12 en deux couleurs et 8 en une couleur) et
- 16 pages (dont 8 en quatre couleurs et 8 en deux couleurs).

Le passage vertical des bandes de papier assure un accès parfait à tous les cylindres porte-plaques. Tous les cylindres tournent sur des cordons largement dimensionnés. Une couche de chrome dur protège les cylindres porte-plaques contre la corrosion. La plieuse (KF 64) peut traiter des produits de 64 pages à la vitesse de 25 000 tours de cylindre/h et de 80 pages à la vitesse de 20 000 tours de cylindre/h. Son capotage contribue nettement à la diminution de bruit.

De la litho directe à l'offset

En 1973, le journal suédois «Eskilstuna-Kuriren» (tirage: 30 000 exemplaires) avait transformé sa rotative typo pour l'utilisation de plaques photopolymères. Certes, on obtenait une bonne qualité d'impression avec ce procédé, mais les frais de production s'avéraient trop élevés. Par ailleurs, il se produisait de sérieux cas d'allergie chez le personnel. On passa donc à la litho directe, mais on vint finalement — en l'espace d'une année — à l'offset. Aujourd'hui, le journal est produit sur une rotative Solna-Distributor avec six unités d'impression (dont quatre groupes d'impression 2+1). Les groupes d'impression 2+1 améliorent la mise en service possible de la machine pour l'impression de travaux de ville après le tirage du journal.

Nouvelle plieuse à mâchoires Wifag

A l'occasion des essais de marche d'une rotative offset OF-5, la fabrique de machines Winkler, Fallert & Co AG (Wifag) à Berne a présenté pour la première fois la plieuse à mâchoires à format fixe FA 80 K 2:3:4 — une construction nouvellement développée. Comme l'indique la désignation du type, elle est équipée d'un cylindre de coupe en deux parties, d'un cylindre à picots et à lames de pli en trois parties et d'un cylindre de pliage à mâchoires en quatre parties et dimensionnée pour une vitesse maximale de 40 000 tours de cylindre/h.

Il existe des plieuses à mâchoires dans des versions très diverses (voir également «techniques de presse» de février 1973, page 14). Mais, dans la pratique, c'est la version avec rapport des cylindres de 2:3:2 et dispositif de pli longitudinal en aval (troisième pli ou pli postal) qui s'est largement imposée dans la plupart des cas. Toutefois, par suite de l'augmentation de la vitesse d'impression, il semble que l'on a maintenant atteint les limites de fiabilité de ce type. Des observations faites dans la pratique et des analyses précises à l'aide de caméras ultra-rapides montrent que les principales difficultés surgissent après la transmission des exemplaires du cylindre à picots et à lames de pli au cylindre de pliage. Des améliorations de détail ne promettent pas une augmentation notable du rendement. Pour cette raison, le problème de la transmission et les effets dynamiques sur les produits du pliage ont fait l'objet d'une étude poussée. Ce faisant, il apparut que l'accélération maximale dépend non seulement de la vitesse d'impression, mais également de la longueur de coupe et du rapport des cylindres. Par ailleurs, il résulta de cette étude que l'on peut augmenter le rendement de la plieuse avec des cylindres de plus grand diamètre dans le cas d'égales pointes d'accélération. Le doublement du diamètre du cylindre de pliage se répercute de manière favorable non seulement sur la conduite de la partie d'exemplaire en avance. Il se produit également un partage en deux des forces centrifuges agissant sur la partie d'exemplaire en retard, ce qui diminue considérablement le risque de formation d'oreilles et de plissages. L'effet sur la transmission de l'exemplaire du cylindre à picots et à lames de pli au cylindre de pliage s'avère pareillement favorable, car la durée d'introduction des lames de pli dans les mâchoires s'en trouve augmentée.

Tous ces arguments menèrent à la nouvelle construction de la plieuse FA 80 K 2:3:4, laquelle est avant tout conçue pour le service mixte (journaux et travaux de ville). Un seul rotativiste peut la transformer en 2 min seulement de la simple à la double production. En liaison avec le listel caoutchouc du cylindre d'accumulation, les deux listeaux de coupe incorporés dans le cylindre de coupe assurent une coupe nette. Pour éviter la «choucroute» lors du collectage, les listeaux de coupe sont montés de façon à permettre un déplacement. Ils coupent le cahier de titre à une longueur légèrement supérieure afin qu'il enveloppe entièrement le cahier de collectage. Le cylindre d'accumulation en trois parties put être repris dans son principe de la plieuse 3:2. Mais, en raison de la vitesse plus élevée, toutes les pièces mobiles ont fait l'objet

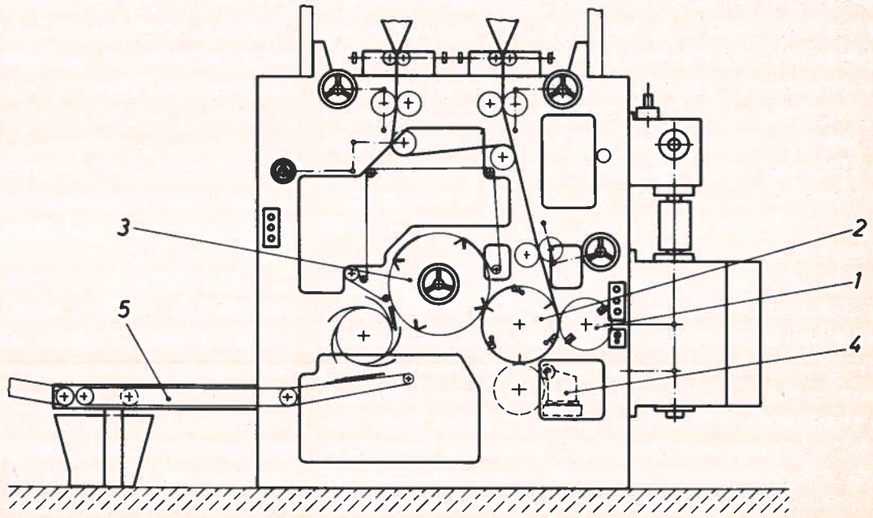


Figure 1: Font partie de l'équipement de base de la plieuse à mâchoires Wifag FA 80 K 2:3:4 un cylindre de coupe en deux parties (1), un cylindre à picots et à lames de pli en trois parties (2), un cylindre de pliage en quatre parties (3) et un aiguillage à gâche (5). Le montage d'une piqueuse à fil métallique (4) est possible ultérieurement.

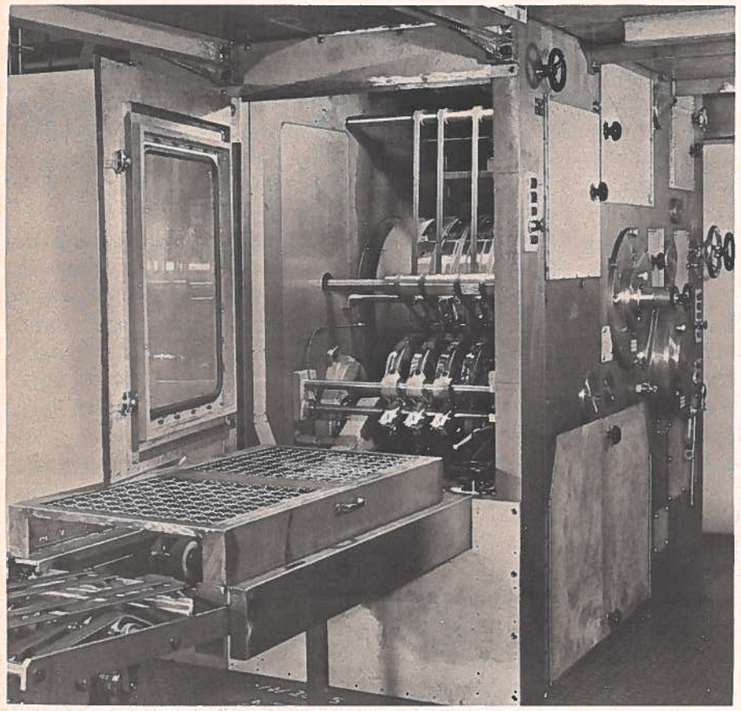


Figure 2: Toutes les ouvertures ménagées dans les bâtis de la plieuse et sur les faces avant et arrière sont munies de portes avec tôles composites anti-bruit. De cette façon, l'émission de bruit provenant de la plieuse ne surpasse plus celle provoquée par les groupes d'impression. On a pourtant un accès facile à tous les organes.

d'un examen sérieux — cela en vue d'obtenir des forces massiques aussi réduites que possible par la diminution des masses mobiles et la conception optimale des courbes de commande. Il en résulta des pressions de trajectoires moins élevées des galets de cames sur les courbes de commande, ce qui se répercute positivement sur l'usure et les bruits de roulement. Un développement nouveau pour le cylindre de pliage en quatre parties permet le décalage central — depuis l'extérieur — de l'ouverture des quatre rangées de mâchoires. Le décalage s'opère à l'aide d'un volant à main avec affichage digital. Cette opération peut s'effectuer tant à l'arrêt que pendant la marche de la rotative. Lors d'un décalage, chaque lame de pli reste toujours au milieu de la mâchoire décalée.

Le montage d'une piqueuse à fil métallique (composée d'un cylindre de piquage en deux parties et d'un dispositif d'amenée de fil avec disque de formage du fil et système de contrôle du fil) est réalisable en tout temps. Il est également possible d'installer des mécanismes pour le deuxième pli longitudinal (deux modules de pliage superposés qui reprennent alternativement les exemplaires sur le cylindre de pliage, les plient à vitesse réduite et les sortent en nappe imbriquée sur deux sorties séparées) et pour le deuxième pli transversal (un autre cylindre qui fonctionne de concert avec le cylindre de pliage équipé de manière correspondante).

Un aiguillage à gâche est monté entre la sortie de la plieuse et la station de remise au transporteur. Il assure l'éjection automatique de la gâche de démarrage et de ralentissement, de la gâche due aux collages et des exemplaires défectueux.

Commande de Sanoma Osakeyhtiö pour un système automatique de transport de bobines . . .

L'entreprise Sanoma Osakeyhtiö à Helsinki (un membre de l'IFRA) vient de passer commande à Cutler-Hammer à Denver (Colorado, USA) pour un système de transport automatique pour bobines de papier journal — un système dont l'installation doit s'effectuer en février 1977 dans une nouvelle imprimerie actuellement en cours de construction à Sanomala. Il alimentera la rotative offset également nouvelle (voir «techniques de presse» de février 1976, page 36) avec des bobines de papier journal pour l'impression du journal «Helsingin Sanomat» paraissant le matin et le dimanche (respectivement 345 000 et 391 000 exemplaires) et du journal tabloïd du soir «Ilta Sanomat» (117 000).

Ce système de transport a un rendement de 3 bobines/min. Dans son exécution initiale, il doit pouvoir alimenter 16 porte-bobines. Dans l'entrepôt de papier, les chariots de transport sont automatiquement chargés avec les formats de bobines réclamés. Les bobines circulent ensuite dans la salle des porte-bobines jusqu'à ce que l'un des porte-bobines ait besoin d'une bobine. Les personnes chargées des porte-bobines rappellent alors la bobine nécessaire dans le circuit à l'aide d'un signal d'aiguillage, puis la chargent manuellement sur le porte-bobines. Le chariot de transport retourne automatiquement à l'entrepôt de papier afin de servir à un nouveau chargement.

En ce qui regarde l'extension et le débit de ce système, il est possible de doubler ces caractéristiques, donc de les adapter aux exigences de production futures. On peut y ajouter une commande par ordinateur sans de trop gros changements. Cutler-Hammer collabore avec une firme finlandaise (Lahden Rautatiollisuus Oy à Lahti) qui fournit les dispositifs de transport pour la liaison entre l'entrepôt principal et l'entrepôt intermédiaire.

. . . et pour une salle d'expédition automatisée de Cutler-Hammer

Cutler-Hammer livrera également le premier échelon de construction d'une salle d'expédition automatisée pour la nouvelle imprimerie de Sanoma Osakeyhtiö. Font partie de l'équipement: des sorties à paquets comptés Mark IV, des transporteurs d'exemplaires et de paquets, ainsi que des machines à emballer et des machines à ficeler. Des aiguillages montés entre les sorties des plieuses et les transporteurs d'exemplaires assurent l'éjection de la gâche imprimée. Chaque sortie à paquets comptés est munie d'un micro-ordinateur enfichable qui permet la programmation manuelle des nombres d'exemplaires pour les paquets standards et les paquets de tête, de même que des différentes couches de paquets. Par ailleurs, il est possible d'indiquer le routage. L'installation de ce matériel est prévue pour mars 1977.

pour sortie à paquets comptés Unité de programmation universelle d'EDS

Développée par EDS-IDAB à Miami (Floride, USA), une unité universelle est commercialisée pour la programmation des types de sorties à paquets comptés les plus fréquemment utilisés (tels que NS330 et NS440 d'IDAB, 251 et 257 de Sta-Hi et Mark III de Cutler-Hammer). En liaison avec des sorties à paquets comptés équipées d'un tourne-pile, elle assure automatiquement la formation de une à quatre couches. La série 506 est prévue pour l'évacuation par une sortie, la série 507 pour l'évacuation par deux sorties. Un clavier numérique sert à l'entrée des quantités à livrer dans la mémoire de l'unité de programmation. Cette mémoire peut enregistrer jusqu'à 800 quantités à livrer (pour différents clients ou points de livraison) avec à chaque fois jusqu'à 7990 exemplaires. Sur la base de ces données, la sortie à paquets comptés forme le nombre nécessaire de paquets standards et un ou deux appoints. On peut interrompre le déroulement des opérations pour former des paquets standards supplémentaires. Un affichage digital visualise en permanence le nombre d'exemplaires encore manquants pour une édition. S'il n'y en a plus que 500, l'unité de programmation donne un signal. Un dispositif additionnel pour la sortie de la sortie à paquets comptés identifie les appoints afin que ceux-ci puissent être munis d'une adresse d'expédition. Lorsqu'on a besoin d'une liste indiquant les quantités à livrer traitées, le nombre de paquets standards et le contenu de l'appoint (ou des appoints), on peut raccorder une imprimante de documents à cette unité de programmation. Par ailleurs, il est également possible de l'équiper pour l'entrée de bandes perforées ou de cartes perforées.

Datek fournisseur de la firme Hell

La maison Dr-Ing. Rudolf Hell GmbH vient de passer une première commande à la firme Datek Systems Limited (Wembley, GB) pour la livraison de 15 terminaux à écran du type S6001. Ces appareils équiperont toutes les futures photocomposeuses Digiset de la série 400 T. On peut relier jusqu'à six terminaux à écran à une machine de cette série.

Plaques photopolymères pour l'impression directe, la prise d'empreinte sur flans et la flexographie

La firme Graphische Verfahrenstechnik Klaus P. Dotzel KG à Bad Homburg (D) a mis au point — sous la désignation de Fibroprint — trois plaques photopolymères. Il s'agit des types Fibropress 91 pour l'impression directe, Fibropress 11 pour la prise d'empreinte sur flans et Fibroflex 31 pour utilisation dans des éléments couleur flexographiques. Notre *tableau* indique les caractéristiques de ces plaques, lesquelles font encore actuellement l'objet d'essais. Le temps de traitement dépend de la machine utilisée pour la préparation des plaques. La masse brute liquide (résine) doit être protégée contre l'action directe du soleil, mais on peut la traiter à la lumière normale du local. Avec un stockage dans des récipients fermés et à la température ambiante, elle se conserve pendant six mois au moins. La plaque terminée résiste à tous les composants d'encre et agents de lavage utilisés pour l'impression des journaux.

Le fabricant souligne le fait suivant: contrairement à ce qui se passe avec les autres genres de plaques, l'utilisateur travaille avec une nappe en fibres plastiques comme matériau-support, et non pas avec une feuille. Dans une installation automatique de préparation des plaques qui se trouve encore en cours de développe-

Nom	Fibropress 91	Fibropress 11	Fibroflex 31
Matériau	polyester	polyester	polyester
épaisseur (mm)	0,5	0,7	2,4
Matériau du support	Nappe en fibres plastiques	Nappe en fibres plastiques	Nappe en fibres plastiques
épaisseur (mm)	0,3	0,3	0,3
Epaisseur totale de la plaque (mm)	0,8	1,0	2,7
Tolérance d'épaisseur (± mm)	0,03	0,03	0,03
Format maximal (mm)	550 x 650	550 x 650	550 x 650
Temps de préparation (min)			
couchage	2	2	2
insolation	3,5	3	10
dépouillement	2	2	2
séchage	2	2	2
exposition complémentaire	1	1	1
Plage de réaction à la lumière (nm)	360 à 420	360 à 420	360 à 420
Agent de dépouillement			
composition	solution aqueuse (alcaline) à 0,5%	solution aqueuse (alcaline) à 0,5%	solution aqueuse (alcaline) à 0,5%
température (°C)	40	40	40
Dureté (Shore D)			
sans exposition complémentaire	85	90	55
avec exposition complémentaire	85	90	65
Gamme des grosseurs de trames (lignes/cm)			
pour le papier journal	jusqu'à 36	jusqu'à 36	jusqu'à 48
Diamètre minimal des points (mm)	0,1	0,1	0,2
Gamme des épaisseurs de point (%)			
dans le cas de la trame 30	5 à 90	5 à 90	8 à 95
Profondeur de relief (mm)			
points des hautes lumières	0,2	0,2	0,2
caractères	0,5	0,7	2,0
Angle des talus (°)	60	60	80
Endurance à l'impression (exemplaires)	1 000 000 (estimation)	—	1 000 000 (estimation)
Résistance à la prise d'empreinte	—	oui	—
Point de ramollissement (°C)			
de la plaque terminée	130	145	130
Point d'ignition (°C)			
de la matière première	34	34	34
Recommandations du fabricant pour			
les négatifs à utiliser	film offset mat	film offset mat	film offset mat
la densité des négatifs	plus de 2.7	plus de 2.7	plus de 2.7

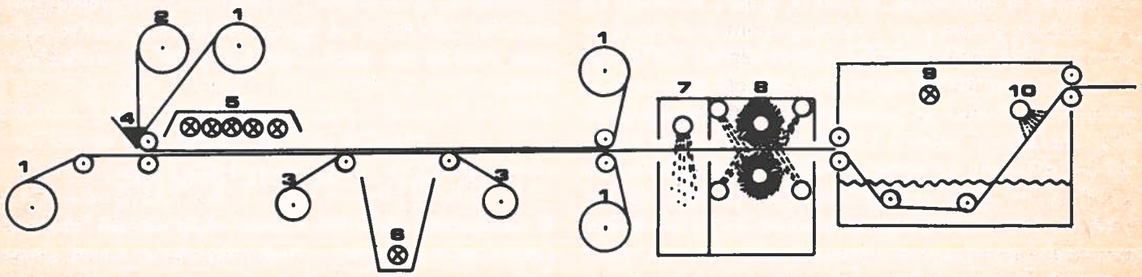


Schéma d'une installation de préparation pour plaques photopolymères Fibroprint. Comme deux bandes de nappes en fibres plastiques circulent côte à côte, on compte avec un rendement horaire de 40 plaques pour l'impression directe. Le temps de préparation pour les deux premières plaques s'élève à 6 min. 1 = bobinages et débobinages pour la feuille de protection, 2 = débobinage de la bande de nappe en fibres, 3 = bobinage et débobinage du film, 4 = couchage du photopolymère, 5 = exposition préliminaire, 6 = exposition principale, 7 = racle à air, 8 = module de dépouillement à lessive, 9 = exposition additionnelle, 10 = séchoir.

ment (voir la *figure*), cette nappe est débobinée d'une bobine d'approvisionnement. Elle sert simultanément de bande de transport pour la plaque jusqu'à ce que cette dernière sorte de l'installation. De plus, le matériau-support repousse les impuretés et, par conséquent, également l'encre.

Nouvelle machine à papier journal pour Ahlström

La firme A. Ahlström Osakeyhtiö vient de commander une machine à papier à Valmet Oy pour son usine sise à Varkaus (y compris un système de ventilation et de récupération de la chaleur). Les investissements totaux se montent à 400 millions de MF, dont 80 millions constituent la part de la commande à Valmet. La production annuelle de la nouvelle machine doit paraît-il atteindre 120 000 t de papier journal avec grammages de 35 à 45 g/m². Sa vitesse mécanique s'élève à 1200 m/min, sa laize de travail coupée mesure 850 cm. La formation de la feuille s'opère à l'aide d'une double toile. Le montage doit commencer en mai 1977 et s'achever à la fin de 1977. L'entreprise prévoit l'utilisation d'égales parties de pâte mécanique et de pâte thermomécanique avec la plus petite addition possible de pâte chimique. Grâce à cette nouvelle machine, les exportations finlandaises de papier journal augmenteront d'environ 10%.

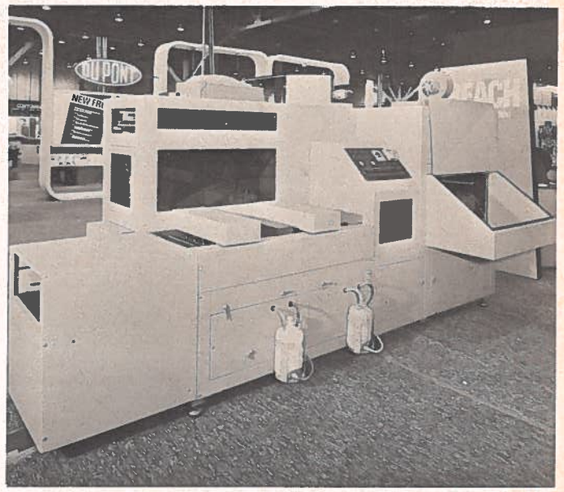
Jusqu'en octobre de l'an dernier, un papier journal produit par le «Daily Telegraph» avait le plus faible grammage des papiers livrés par Varkaus, à savoir 28 g/m². Depuis, l'usine fabrique également un papier journal de 25 g.

Nouvelle installation de préparation de plaques Beach

Une installation commercialisée par Beach pour la préparation de plaques offset ou de plaques pour la litho directe fonctionne de manière entièrement automatique et peut être chargée avec 50 négatifs au maximum. En indiquant le nombre désiré au moyen d'un bouton sélecteur, on peut préparer une ou plusieurs plaques à partir de chaque négatif. Les plaques d'aluminium brut sont soit amenées dans la machine par l'intermédiaire d'un margeur à plaques isolées, soit coupées d'une bobine. Chaque plaque brute passe d'abord dans un dispositif de couchage. Puis la couche sensible à la lumière est séchée à l'aide de rayons infrarouges. Ensuite, un dispositif perfore des trous de registre dans la plaque et une table à vide l'achemine vers le module d'insolation.

Les négatifs perforés en registre sont logés dans une cassette. La machine prélève un négatif dans cette cassette avec un cadre à vide et le dépose sur la plaque. Le contact entre négatif et plaque s'opère par le vide. Un intégrateur de lumière commande l'insolation. Après achèvement de l'insolation, le négatif et la plaque sont séparés l'un de l'autre. Le négatif reste dans la machine jusqu'à ce que toutes les plaques requises soient insolées, tandis que la plaque continue son chemin vers le module de développement. Là, elle est développée, rincée, gommée et séchée. Les plaques terminées peuvent être soit stockées provisoirement pour utilisation ultérieure, soit amenées directement à une machine à replier les bords.

Le temps de passage d'une plaque s'élève à 45 s. Dans des conditions de production normales, la machine peut préparer 120 plaques/h. Une bobine permet la préparation de 3000 plaques. Comme



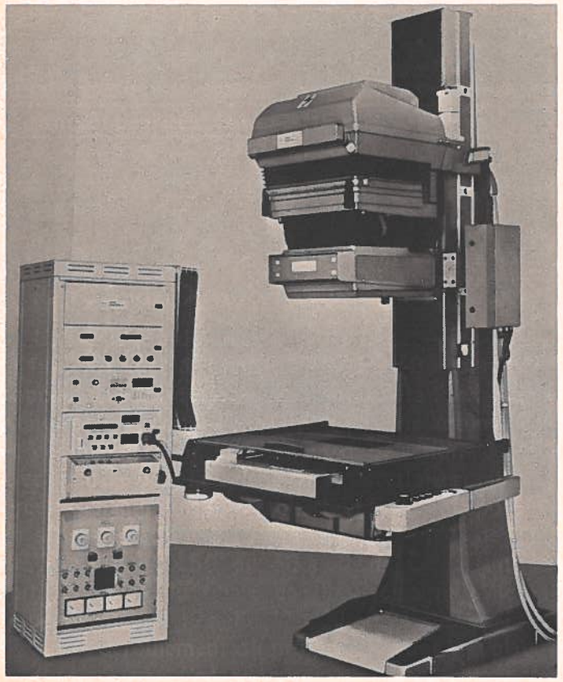
matériel complémentaire ou matériel de réserve pour l'installation automatique, Beach offre une ligne de traitement manuelle comprenant un module automatique pour la perforation en registre, le couchage et l'empilage, ainsi qu'un module de développement pour 16 plaques/min.

Pawo-Super-Xenotron/Rapidomat pour la fabrication automatique de sélections couleur

L'installation de précision Rapidomat – conçue par la firme Wagner & Cie SA à Oberburg-Burgdorf (CH) comme accessoire spécial pour la caméra Pawo-Super-Xenotron – permet l'exposition en série automatique et commandée par programme de sélections couleur avec tramage direct ou demi-tons (sélections combinées tirées à chaque fois sur un quart du film). L'exposition en série se pratique à choix avec des formats de films de 30 x 40, 40 x 50 ou 50 x 60 cm. Ce faisant, les formats utiles du quart de film concerné s'élèvent respectivement à 12 x 17, 17 x 23 ou 23 x 27 cm.

Après déroulement du programme choisi, la plaque à succion se déplace automatiquement dans les positions d'exposition isolées afin d'exposer les quatre couleurs partielles sur le film. Une couverture étanche à la lumière – avec ouverture au centre de l'axe optique – ne laisse toujours ouverte que la couleur partielle à exposer. Toute la suite des opérations d'exposition principale et additionnelle ainsi que le changement de filtres et d'obturateurs s'opèrent de manière automatique. Les valeurs de luminosité nécessaires à chaque fois sont mémorisées dans l'installation.

Pour les sélections couleur avec tramage direct, on utilise ce qu'on appelle une trame de contraste combinée. La source lumineuse à haut rendement (xénon) a une puissance de 16 000 W. Elle est réglable sans échelons dans la plage de 1 à 100. Les dispositifs automatiques de réglage et de mise au point fonctionnent avec une précision absolue. De concert avec un photomètre digital intégré, un système électronique de commande de l'exposition assure une exactitude parfaite des valeurs tonales. Par ailleurs, un dispositif revolver permet une sélection automatique entre cinq objectifs de diverses distances focales et le couvrage sans échelons de la gamme de reproduction entre 50 et 2000%.



Une Koebau-Commander pour EMAP

Pour son imprimerie de périodiques East Midland Litho Printers, l'entreprise East Midland Allied Press (EMAP) à Peterborough (GB) vient de commander une rotative offset Koebau-Commander avec trois trèfles, un groupe planétaire 4 couleurs, deux unités d'impression blanchet/blanchet, trois séchoirs et une plieuse.

Deuxième système Cepamat pour Holtzmann

Comme un système Cepamat de Siemens a fait ses preuves sur l'une de ses machines à papier journal, l'entreprise E. Holtzmann & Cie SA a également commandé un tel système pour la nouvelle machine de son usine sise à Wolfsheck (voir «techniques de presse» de janvier 1976, page 52). Le système Cepamat fonctionne avec un ordinateur pour la commande des processus Siemens 320. Il comprend des dispositifs de mesure pour le grammage, l'humidité, l'épaisseur et la teneur en cendres, des pupitres de contrôle avec affichages sur moniteurs couleur, des systèmes de régulation pour le grammage, l'humidité, la quantité de matières et l'accumulation de matières, un dispositif d'optimalisation des valeurs prescrites et, enfin, un système complet de préparation des données pour les affichages et la sortie de protocoles.

Güttinger fabrique la Copytronic

A l'avenir, la photocomposeuse Copytronic de la maison Dr Böger Photosatz GmbH (Wedel, D) sera fabriquée par la firme Güttinger AG (Niederteufen, CH) et également commercialisée en Suisse. La maison allemande continue à manufacturer les porte-caractères pour la Copytronic.

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Workshops «L'électronique à la rédaction»
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19/20 et 21/22 octobre 1976
Darmstadt
Workshops «L'électronique à la rédaction»
en néerlandais (seulement pour membres de l'IFRA)

26/27 et 28/29 octobre 1976
Darmstadt
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Darmstadt
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Darmstadt
Workshop «L'électronique à la rédaction»
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LES ASPECTS HUMAINS DU TRAVAIL A DES TERMINAUX A ECRAN

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LES ASPECTS HUMAINS DU TRAVAIL
A DES TERMINAUX A ECRAN

PREFACE

Le but de ce rapport est de récapituler certains aspects de la conception des terminaux à écran et du travail à ces derniers, à savoir ceux des aspects en relation avec l'efficience, le confort et le bien-être des opérateurs. En présentant cette simple description des caractéristiques principales de la conception des terminaux, des places de travail et des locaux, nous espérons procurer aux cadres supérieurs des imprimeries de journaux une meilleure compréhension des «aspects humains» du travail à des appareils à écran.

Cet exposé de la situation a été entrepris en vue de fournir une base pour de futures recherches possibles — patronnées par l'IFRA — dans ce domaine. Pour cette raison, les informations contenues dans ce rapport ont été tirées des résultats de nombreuses études publiées dans des revues d'ergonomie, dans des manuels spécialisés et dans des rapports antérieurs.

David J. Hart
Février 1976

TABLE DES MATIERES

INTRODUCTION

Le terminal à écran a fait ses preuves en tant que dispositif extrêmement souple et fiable. Cela est amplement corroboré par le fait que des dispositifs de ce genre sont devenus partie intégrante de systèmes pour le traitement de graphiques et d'informations dans nombre d'applications industrielles, gouvernementales et militaires.

En l'espace des quelques prochaines années, on peut s'attendre à ce que les terminaux à écran deviennent une partie intégrante — dans l'industrie des journaux également — des systèmes de saisie des textes, de rédaction et de mise en page. Toutefois, le succès avec lequel on peut mettre entièrement à profit les avantages offerts par les terminaux comparativement aux procédés traditionnels dépendra assurément — dans une très large mesure — de l'évaluation faite par les cadres supérieurs de la production et les rédacteurs en chef lors de la sélection des équipements à écrans — avant tout en ce qui regarde les types et les capacités qui s'avèrent les plus favorables pour leurs besoins particuliers. Ledit succès dépendra également de leur évaluation lors de la planification des places de travail et de la configuration hors-tout du centre de terminaux en vue de créer une ambiance dans laquelle le personnel peut travailler avec un sentiment de confort.

Le premier critère pour la sélection d'un type particulier d'équipement de terminaux à écrans est l'aptitude à exécuter le travail en question. Cependant, il existe un large éventail d'autres facteurs que l'on devrait soigneusement soupeser afin d'être en mesure non seulement de satisfaire les exigences fonctionnelles de l'équipement, mais également de tenir compte de l'efficience et du confort des opérateurs. Ces facteurs sont appelés «facteurs humains».

EFFETS PHYSIOLOGIQUES DU TRAVAIL A DES TERMINAUX A ECRAN

Comme les ordinateurs et les dispositifs d'affichage n'ont cessé de trouver une gamme de plus en plus large d'applications dans le traitement de l'information, dans la commande des processus et dans la gestion, les conditions de travail de la main-d'oeuvre ont fait l'objet de modifications qui — dans la plupart des cas — se sont révélées des changements en bien. Une plus grande attention a été attachée à la gestion des travaux et à la planification des locaux — pour certaines applications, voire même dans la mesure d'une décoration et d'un paysage améliorés des locaux —, et l'expérience montre que ces mesures ont conduit à un environnement de travail plus agréable et plus stimulant. Toutefois, dans le cas de quelques-unes des nombreuses catégories d'opérateurs de terminaux à écran dans l'industrie et dans les services gouvernementaux — et spécialement dans le cas des opérateurs qui doivent travailler devant un écran pendant des périodes de temps longues et ininterrompues —, les collaborateurs concernés se sont souvent plaint de désagréments tels que forte contraite des yeux, maux de tête et fatigue.

Bien sûr, on sait parfaitement bien que tous les genres de travaux qui forcent une personne à demeurer pendant longtemps dans une position essentiellement identique et à faire attention à une tâche ou à un objet spécifiques engendrent tout particulièrement des sensations de contrainte et de fatigue. Cette remarque serait pareillement valable indépendamment de ce que pourrait représenter l'objet en question: une copie, une machine à écrire ou un écran. Et l'un des plus importants facteurs qui aggravent les sensations de contrainte et de fatigue est l'incapacité de se reposer vraiment. Toutefois, jusqu'à présent, rien ne permet d'avancer en toute évidence que les genres de travaux pour lesquels on introduit des dispositifs d'affichage dans les entreprises de journaux donnent nécessairement naissance à des problèmes de cette nature. Pris hors de leur contexte, des rapports de cette sorte sur l'inconfort des opérateurs peuvent néanmoins s'avérer perturbateurs, voire trompeurs. Et, en considérant des questions de ce genre, on ne devrait pas perdre de vue le fait que des plaintes d'inconfort — même chez ceux des groupes d'opérateurs de terminaux dont la tâche peut être tenue pour particulièrement susceptible de mener à une contrainte et à de la fatigue — constituaient jusqu'à maintenant bien plus une exception que la règle. Ainsi, sans vouloir sous-estimer la portée de plaintes telles que celles-ci, il est indispensable d'observer cette sorte de problème dans sa vraie perspective.

Au cours des dernières années, plusieurs études ont été entreprises par des spécialistes en ergonomie, des autorités médicales et des fabricants d'équipements afin de mieux comprendre la nature et les causes des plaintes relatives aux yeux et à l'inconfort chez les opérateurs de terminaux à écran. Mais, malheureusement, peu de ces études se rapportent directement aux conditions régnant dans les entreprises de journaux ou — voire même — on ne peut les considérer comme adéquatement représentatives desdites conditions. Cependant, les conclusions et les résultats de ces

études constituent une aide utile pour expliquer les conditions dans lesquelles on peut s'attendre à entendre des plaintes de la part des opérateurs concernant l'inconfort. Chose beaucoup plus importante, ces études ont permis d'éclaircir les principales caractéristiques de la conception des terminaux, la sélection des terminaux et le travail avec les terminaux pour minimiser les risques d'inconfort des opérateurs. Mais, afin de comprendre la signification de quelques-uns de ces résultats, il vaut la peine de passer quelques instants à examiner plus en détail l'origine et la nature des plaintes à propos de la fatigue.

CONTRAINTE DES YEUX ET FATIGUE

Le maillon le plus sensible entre l'opérateur d'un terminal et le dispositif d'affichage est le contact visuel entre les yeux et l'écran. Par conséquent, la chose suivante ne s'avère pas surprenante: dans les cas où les opérateurs de terminaux se sont plaint d'inconfort, la plupart de ces plaintes avaient trait à ce que l'on décrit communément — quoique souvent plutôt vaguement — par le terme de «contrainte des yeux». Plus précisément, de telles plaintes portaient sur des sensations de «brûlure» dans les yeux, sur des élancements dans les muscles oculaires, sur des maux de tête, voire même — dans quelques cas — sur une altération de la vision et de la perception des couleurs. En fait, les symptômes de la fatigue visuelle sont variés — tout comme le sont également les facteurs susceptibles de provoquer ou d'accélérer la fatigue visuelle lors du travail. Par conséquent, il vaut la peine d'examiner les problèmes spécifiques qui peuvent surgir en relation avec le travail à des dispositifs d'affichage.

Les facteurs qui peuvent conduire dans la pratique à une plus ou moins grande sensibilité à la fatigue visuelle n'ont pas tous un rapport direct avec le travail visuel même. Donc, pour commencer, il importe de faire une distinction entre ce que l'on peut appeler des origines personnelles et des origines professionnelles de la fatigue visuelle.

Les plus importants facteurs qui peuvent déterminer les probabilités de fatigue visuelle lors du travail sont les suivants:

* effets des défauts ou anomalies de l'oeil
— presbytie, défaut d'accommodation, astigmatisme;
* facteurs corporels
— fatigue, mauvaise santé, fumée, boisson, etc.;
* âge;
* position lors du travail.

Des défauts de l'oeil et d'autres conditions susceptibles d'occasionner une surcharge des muscles oculaires aggravent inévitablement le risque de contrainte des yeux durant des périodes de travail prolongées. Et, bien qu'il soit usuel de considérer la

fatigue comme un facteur exerçant son action sur des personnes «normales», les défauts de la vision sont chose courante même chez les jeunes adultes et la règle chez les personnes dont l'âge dépasse 40 ans. L'utilisation de lunettes ne constitue pas toujours en elle-même une garantie de guérison des défauts de l'oeil: c'est ce que prouvent les résultats d'une série de tests effectués avec plus de 500 employés de bureau pour le contrôle de l'acuité visuelle. 50% du groupe présentait des défauts non corrigés de la vision, 37% des porteurs de lunettes devaient faire l'objet d'un nouvel examen de l'oculiste pour l'établissement d'une nouvelle ordonnance et 69% des personnes ne portant pas de lunettes avaient besoin d'une correction de la vue.

Les probabilités de fatigue visuelle lors de travaux nécessitant une vision rapprochée ou une constante attention visuelle augmentent avec l'âge — cela en raison d'un certain nombre de facteurs reliés à la détérioration générale du système optique. Par exemple, le point de vision rapprochée s'éloigne de 10 à 75 cm durant la vie de travail normale d'une personne, et le recul au-delà d'environ 25 cm se produit généralement à l'âge de 45 ans. D'autres effets de l'âge sur la sensibilité à la fatigue visuelle peuvent être compensés — dans une certaine mesure — par un bon éclairage. Lorsque nous prenons de l'âge, la grandeur de la pupille subit une diminution. Le résultat en est qu'une plus faible quantité de lumière entre dans l'oeil et, suivant des estimations, la quantité de lumière atteignant la rétine à l'âge de 60 ans ne représente qu'environ le tiers de celle enregistrée à l'âge de 20 ans.

Quoique des considérations relatives à la position de travail ne peuvent guère paraître pertinentes en ce qui concerne la fatigue visuelle, tel n'est en fait pas le cas. L'obligation de rester assis ou debout pendant de longues périodes de temps dans une position essentiellement statique provoque également de la fatigue et — selon la position de travail — peut facilement mener à des maux de tête et à des douleurs dans le cou et le dos. Quelques-uns de ces symptômes sont non seulement confondus aisément avec ceux de la fatigue visuelle, mais on pourrait en outre s'attendre à ce que la fatigue corporelle due à une mauvaise position de travail accélère la fatigue visuelle. Par conséquent, il n'est pas hors de propos d'attacher une attention marquée à la conception de la place de travail et — tout spécialement — des sièges, de même qu'aux hauteurs de travail.

Dans l'exemple spécifique du travail à des dispositifs d'affichage, les *facteurs professionnels* susceptibles d'affecter l'incidence de la fatigue visuelle ont rapport avec les caractéristiques des terminaux, avec le genre et le mode de travail et avec l'environnement de la place de travail:

* facteurs en relation avec l'appareil d'affichage
- grandeur des caractères, espacement et foyer (lisibilité);
- luminosité de l'écran;
- «scintillement» de l'écran;
- émission de radiations.

* facteurs en relation avec le genre et le mode de travail
- durée des périodes de travail ininterrompues;
- degré de concentration requis;
- arrêt possible du travail à volonté.

* facteurs en relation avec l'environnement de la place de travail
- niveau d'éclairage;
- disponibilité de lumière du jour ou de lumière artificielle;
- surfaces réfléchissantes telles que fenêtres, revêtements des murs, etc.

Lors de la sélection de l'équipement, il convient d'attacher une attention particulière à la lisibilité de l'affichage. Les caractères devraient avoir des contours nets et un espacement suffisant de façon que l'opérateur ne doive pas se livrer à des efforts exagérés pour lire le texte à la distance normale de travail. Il faut également bien faire attention au contraste de luminosité entre l'écran et l'arrière-plan de travail. Un contraste trop réduit tendrait à affaiblir la netteté de l'affichage, tandis qu'un trop grand contraste pourrait donner naissance à des problèmes d'éblouissement. Par conséquent, dans un environnement donné du local, il existe probablement un équilibre optimal entre la luminance de l'écran et le niveau d'éclairage de l'arrière-plan. Fondamentalement, on ne devrait pas voir l'écran sur un arrière-plan trop sombre, et il faudrait éliminer toute perturbation optique additionnelle — due à des réflexions venant des fenêtres ou des lampes — en plaçant l'appareil à écran à un endroit adéquat et en installant des écrans sur les sources de lumière artificielle. En règle générale, les terminaux ne devraient pas être situés à des endroits obligeant les opérateurs à se trouver en face d'une fenêtre.

On a également fait naître l'idée que l'éclairement et l'obscurcissement périodiques de l'affichage — ce que l'on désigne parfois par «scintillement de l'écran» — constitue une cause potentielle d'inconfort des yeux. Nous traitons cette question plus en détail dans l'un des chapitres suivants. Toutefois, il vaut la peine de noter ici que l'on a quelques raisons de penser que la perceptibilité du scintillement de l'écran dépend non seulement des propriétés de fluorescence rémanente du phosphore de l'écran (avec des phosphores présentant une haute fluorescence rémanente, des taux de régénération relativement réduits s'avèrent suffisants pour éviter la perception du scintillement), mais également du niveau de luminance de l'écran. Le taux critique de régénération augmente en fonction directe de la luminosité de l'écran, si bien que la perceptibilité du scintillement de l'écran se révèle moindre dans le cas d'un affichage «obscur» que dans le cas d'un affichage clair. Une fois de plus, ceci fait ressortir l'importance de pouvoir contrôler la luminosité de l'écran afin d'être à même de trouver un équilibre ad hoc entre la netteté de l'affichage, l'éblouissement et la perceptibilité du scintillement de l'écran.

Néanmoins, en évaluant la signification spéciale des plaintes dues au travail à des terminaux à écran à l'encontre d'autres genres d'activités, il y a un certain nombre de «règles ordinaires» qu'il est bon de garder dans l'esprit:

* plus la période de travail est longue, plus les probabilités d'une sensation de contrainte et de fatigue s'avèrent grandes;
* plus la période de travail sans interruption est longue et
* plus de degré de concentration requis pour l'exécution du travail se révèle élevé, plus il devient probable que de telles sensations se produiront rapidement;
* l'expérience montre que des pauses permettant au personnel de se reposer ou d'exécuter d'autres tâches atténuent la tendance à la fatigue et à des sensations de contrainte.

Puisque le travail ininterrompu et prolongé mène généralement à des sensations de contrainte et de fatigue, on s'attend à ce que l'incidence de la fatigue visuelle lors du travail à des dispositifs d'affichage dépendra beaucoup — dans la pratique — de la manière dont sont utilisés les terminaux à écran. Si l'on n'emploie qu'occasionnellement les terminaux ou si la nature ou l'organisation du travail ne rendent pas nécessaire l'observation continuelle de l'écran, les probabilités de fatigue visuelle sont considérablement moindres que dans les cas où les opérateurs de terminaux doivent constamment faire attention à l'écran.

On a fait naître l'idée que la performance du travail tend à se détériorer après des périodes de travail continues variant de quatre à six heures. Dans le cas spécifique du travail à des dispositifs d'affichage, il y a donc quelque évidence pour affirmer que la vision de l'opérateur présenterait des signes d'affections temporaires — telles que contrainte des yeux, voire peut-être une altération de la perception des couleurs — après une période de travail ininterrompue de quatre heures passées à l'observation de l'écran. Mais, au moins l'une des études a montré que des opérateurs de claviers-perforateurs et des dactylographes sont sujets à une importante augmentation des sensations subjectives de fatigue après quatre et six heures avec des périodes de travail consécutives variant de une à deux heures.

Les facteurs que nous avons mentionnés dans ce chapitre font ressortir un certain nombre de précautions que l'on peut prendre en vue d'éliminer quelques-unes des plus évidentes causes de l'inconfort des opérateurs. Et nous nous sommes efforcés de les détailler sous la forme d'une «check-list» à la fin de ce rapport.

EFFETS DE L'ENVIRONNEMENT

Lorsqu'on choisit des terminaux à écran, il n'y a pas beaucoup de caractéristiques de l'appareil même qui soulèvent de sérieux problèmes d'environnement. Cependant, il vaut la peine de mentionner trois types d'émissions.

Chaleur et bruit

Comme toutes les pièces des équipements électriques ou électroniques, les terminaux à écran ne sont pas entièrement exempts de pertes. Et, après une longue période de fonctionnement, ils sont capables d'engendrer une *chaleur* suffisante pour «réchauffer» leurs composants et même — dans les locaux avec un grand nombre d'unités — de faire augmenter la température ambiante. A condition que cela ne compromette pas la fiabilité des appareils eux-mêmes, la génération de chaleur ne constitue usuellement pas un problème sérieux. Toutefois, si l'on pense — pour une raison quelconque — que cette forme de génération de chaleur peut devenir problématique, on devrait alors prévoir une ventilation adéquate.

La seule source de *bruit* importante d'un terminal à écran est le clavier. Et, quoique des claviers à fonctionnement silencieux soient un moyen évident pour éviter le bruit, les niveaux de bruit hors-tout s'avèrent en tout cas beaucoup moins élevés que ceux d'une salle équipée de machines à écrire traditionnelles.

Radiations

L'origine de la contrainte des yeux et des maux de tête des opérateurs de terminaux a été attribuée à un grand nombre de facteurs, dont les plus plausibles et les mieux prouvés sont des conditions d'éclairage défectueuses ou mal contrôlées et un repos insuffisant. Mais il y a aussi eu quelque inquiétude à propos d'une autre cause possible de la contrainte des yeux et des maux de tête, et il vaut la peine d'étudier ce point en détail afin de dissiper les craintes que les opérateurs pourraient émettre à ce sujet. Il s'agit de l'émission de radiations X par les appareils à écran.

Dans des terminaux à écran — des appareils par ailleurs entièrement transistorisés —, le tube cathodique constitue la seule source possible de rayons X. Et la force d'émission dépend de la tension de sortie de l'alimentation à haute tension. La même remarque s'applique à tous les téléviseurs entièrement transistorisés (téléviseurs noir et blanc ou couleur).

L'inquiétude relative aux rayons X des appareils à écran remonte aux années 60 — époque à laquelle on venait de commercialiser la télévision en couleur. De nombreux contrôles de routine quant aux radiations furent effectués à ce moment-là sur des téléviseurs, et l'on découvrit que — dans quelques cas — les niveaux d'émission de

radiations étaient plus élevés que les niveaux admissibles. Les résultats d'une autre série de mesures détaillées faites aux Etats-Unis montrèrent par exemple que 16% d'un total de 1000 téléviseurs émettaient des quantités de rayons X excédant les valeurs recommandées.

Comme résultat des études de ce genre, les caractéristiques d'absorption des tubes cathodiques ont fait l'objet d'essais et de développements poussés. Et, à l'heure actuelle, les rayons X émis par des dispositifs à écran fonctionnant avec une tension inférieure à 25 kV ne sont plus considérés comme un problème.

Mais, afin de placer cette question dans une perspective plus claire, nous indiquons ci-après les prescriptions en vigueur aux Etats-Unis et en Grande-Bretagne concernant les dosages admissibles de rayons X.

Suivant les prescriptions du Département du travail des Etats-Unis, registre fédéral de l'administration OSH, juin 1974:

Dosage admissible de rayons X	Remarques
1,25 rem/trimestre	corps entier, cristallin de l'oeil, gonades
18,75 rems/trimestre	mains, avant-bras, pieds, chevilles
7,50 rems/trimestre	épiderme du corps

Clauses spéciales

(1) Aucun employeur ne doit permettre à n'importe quelle personne âgée de moins de 18 ans de recevoir — pendant un trimestre quelconque du calendrier — une dose excédant 10% des limites spécifiées dans le tableau.

(2) Les quatre périodes d'une année de calendrier peuvent consister en les 14 premières semaines complètes et consécutives du calendrier, les 14 semaines du calendrier suivantes, complètes et consécutives et les 12 dernières semaines complètes et consécutives du calendrier.

En Grande-Bretagne, les dosages admissibles de radiations ionisantes sont définis comme suit dans les Prescriptions relatives aux radiations ionisantes (sources scellées), 1969, HMSO No 808:

Doses maximales admissibles

	Radiations ionisantes quelconques		Rayons X, rayons gamma et neutrons	
Parties du corps	Trimestre du calendrier	Année du calendrier	Trimestre du calendrier	Dose cumulative
Mains, avant-bras, pieds et chevilles	40 rem	75 rem		
Cristallin de l'oeil	8 rem	15 rem		
Autres parties du corps	15 rem	30 rem	3 rem*	5 (n-18) rem

Remarques spéciales: (1) Une personne qui travaille pendant une période quelconque de son temps dans une zone de radiations dont la dose dépasse 0,75 millirem/h (mr/h) doit être classifiée.

*(2) Le taux de dosage maximal admissible pour les femmes s'élève à 1,3 rem/trimestre.

(3) Lorsqu'une grossesse est connue, la dose totale admissible pour la période de la grossesse est 1 rem.

Si, à titre d'exemple, nous examinons les prescriptions courantes du Département du travail des Etats-Unis pour toutes les personnes âgées de plus de 18 ans et si nous nous basons sur un trimestre de 12 semaines, sur une semaine de travail de 5 jours et sur une journée de travail de 8 heures, nous arrivons à une période de travail totale de 480 heures. La limite supérieure correspondante d'exposition des yeux aux radiations se monterait alors à $2{,}6 \times 10^{-3}$ rem/h ou 2,6 mr/h. Pour le groupe au-dessous de 18 ans, la limite correspondante se chiffre par un dixième de cette valeur, soit par 0,26 mr/h.

A la suite de réclamations concernant des maux de tête chez les opérateurs de terminaux des agences AP et UPI aux Etats-Unis, la Wire Service Guild a fait entreprendre des mesures de radiations qui s'effectuèrent sous la juridiction du Département du travail. Les mesures furent faites à des terminaux Harris 1100 à l'agence UPI et à des terminaux Hendrix EDS 5200 à l'agence AP. Les deux séries de mesures n'ont pas fait apparaître des niveaux de radiations dépassant les doses fixées par les prescriptions. En fait, à la distance prescrite de 5 cm d'avec la surface de l'écran, les niveaux de radiations mesurés n'étaient pas plus élevés que le niveau du fond, c'est-à-dire environ 0,01 à 0,02 mr/h. On est arrivé à la même conclusion dans le cas de quelques terminaux de rédaction IBM.

Sur la base des prescriptions américaines, ces niveaux correspondent à un facteur de sécurité d'environ 130 pour toutes les classes d'âge et d'environ 13 pour le groupe en dessous de 18 ans. Ainsi, même si les niveaux d'émission de radiations étaient 130 fois plus grands que ceux des types d'appareils à écran existants, la vue et la santé des opérateurs de terminaux ne seraient pas mises en danger. Comme les dosages prescrits contiennent déjà une substantielle marge de sécurité, les vrais facteurs de sécurité sont considérablement plus élevés.

Par ailleurs, dans une communication reçue des autorités compétentes de Grande-Bretagne (UK Health and Safety Executive), on pouvait lire ce qui suit:
«Comme résultat de ces mesures (blindages améliorés), des dispositifs d'affichage, des terminaux, des tubes cathodiques et des téléviseurs fabriqués et/ou utilisés dans ce pays (Grande-Bretagne) ont conduit depuis quelques années à une protection adéquate bien inférieure à 0,75 mr/h à n'importe quel point ou près de la surface de l'appareil — ce niveau étant généralement de l'ordre de 0,1 mr/h ou moins.»

En se basant sur ces investigations, on peut donc conclure qu'il n'y a aucune raison de craindre que la faible émission de rayons X des terminaux à écran ne représente — de quelque façon que ce soit — un danger quelconque pour les opérateurs.

CONCEPTION ET LAYOUT DES TERMINAUX

La haute fiabilité du tube à rayons cathodiques (TRC) et la large gamme de dimensions des écrans que l'on peut fabriquer rendent ce dispositif particulièrement adéquat pour les dispositifs d'affichage de systèmes commandés par l'ordinateur. Les types de terminaux à écran utilisés pour le traitement des textes à l'entrée peuvent être considérés sous l'optique de trois composants principaux, à savoir l'écran lui-même, le clavier et les caractéristiques d'affichage des informations sur l'écran. Les particularités de ces trois composants influent de manière significative sur la norme de performance aux terminaux.

CLAVIERS

Layout des claviers

Plus de 100 ans après son invention, le layout de clavier dit QWERTY (QWERTZ dans le cas du français) est toujours le layout le plus communément mis en oeuvre pour les claviers de machines à écrire et de terminaux. En fait, il est devenu une sorte de norme internationale. Mais, nonobstant la préférence continuelle pour la conception QWERTY, la disposition relative des caractères ne fut pas choisie — comme on le suppose ordinairement — pour la commodité de l'opérateur, mais bien

pour des raisons procédant de la construction du mécanisme de barres porte-caractères dans les machines à écrire mécaniques. Pour éviter le choc de deux barres porte-caractères, les touches pour les paires de lettres les plus usuelles («digrams») sont bien séparées sur le clavier dans le cas de la langue anglaise. Et, parce que quelques-unes des paires de lettres se présentant le plus fréquemment sont tapées alternativement par les deux mains, le clavier QWERTY permet de la sorte — quoique inintentionnellement — une augmentation de la vitesse de frappe.

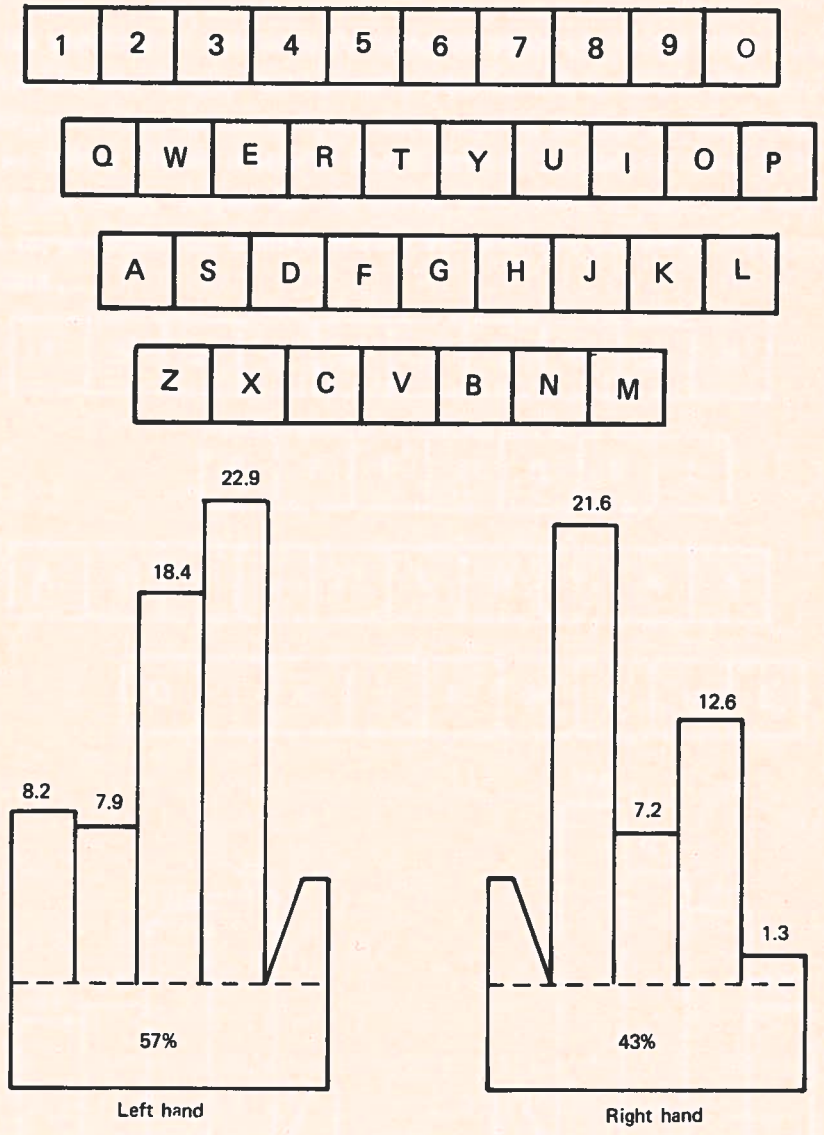

Figure 1: Layout du clavier QWERTY et répartition de la charge de travail (d'après Stewart).

De manière idéale, la charge de travail devrait être supportée par la main droite, laquelle est généralement — à tout le moins pour la plupart d'entre nous — la main préférée. Et, pareillement, la charge de travail pour les divers doigts devrait diminuer

depuis l'index en accordance avec la force décroissante des doigts. En outre, suivant des recommandations faites, la partie principale de la charge de travail devrait être concentrée sur la rangée centrale. Par conséquent, sous l'optique de principes strictement ergonomiques, on peut critiquer le layout de clavier QWERTY dans la mesure où environ 60% de la charge de travail sont pris en charge par la main gauche. Et, dans le cas de la langue anglaise, la frappe s'effectue (en moyenne) beaucoup trop sur la rangée arrière (environ 50%) et pas assez sur la rangée centrale (environ 30%).

De toutes les nombreuses solutions de remplacement que l'on a mises au point pour le layout des claviers, la plus connue est probablement le clavier DVORAK que l'on avait développé en vue de concentrer davantage la charge de travail dans la main droite et, en même temps, d'assurer une distribution plus régulière de la charge de travail entre les divers doigts. Sur le clavier DVORAK, la frappe se fait à environ 70% sur la rangée centrale, à environ 20% sur la rangée arrière et à environ 10% sur la rangée avant.

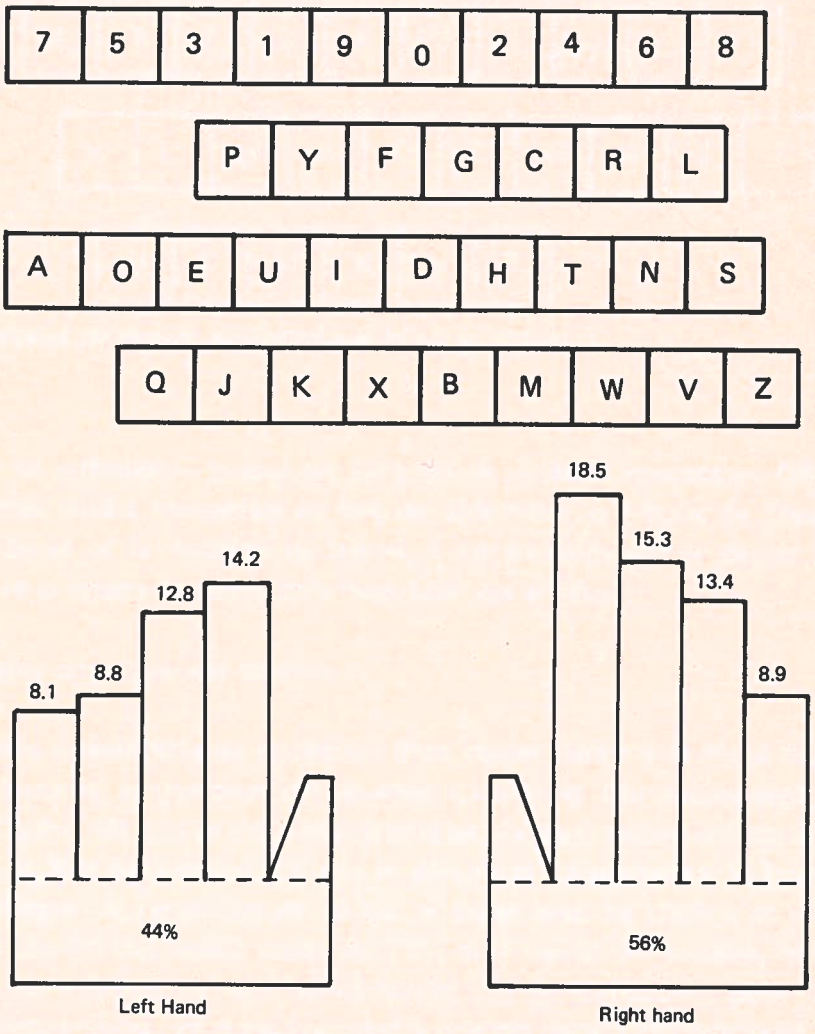

Figure 2: Layout du clavier DVORAK et répartition de la charge de travail (d'après Stewart).

On a prétendu que le layout du clavier DVORAK réduit le temps de formation nécessaire et que – dans le cas d'opérateurs expérimentés – ce layout particulier de clavier permet des rendements plus élevés (en mots minute). Mais, en dépit de plusieurs études entreprises pour la comparaison du rendement et de l'efficience des opérateurs, ces affirmations n'ont jamais été prouvées de manière satisfaisante. Et, dans certains cas, on arrivait plutôt à un résultat contraire.

En plus du clavier DVORAK, on a mis au point plusieurs autres configurations de claviers. Mais, à part quelques exceptions, toutes se sont avérées éphémères. Parmi les exceptions, on trouve cependant quelques claviers alphabétiques simplifiés et quelques layouts de claviers spécialisés pour des applications dans le domaine de la composition.

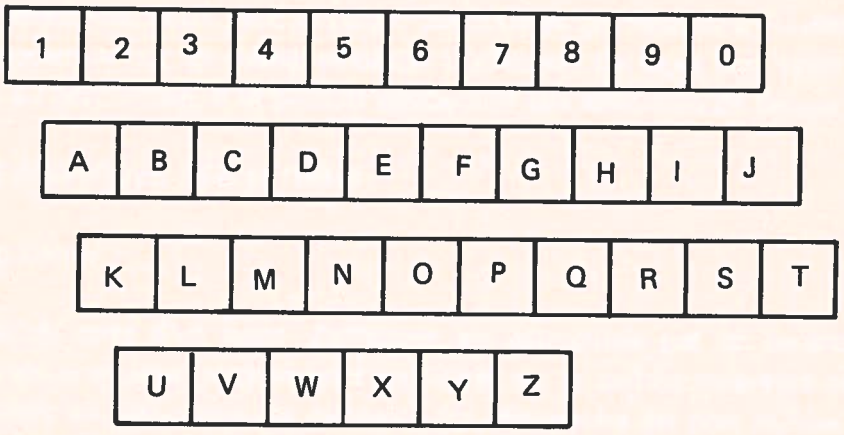

Figure 3: Layout de clavier alphabétique (d'après Stewart).

Nonobstant les critiques – basées sur l'ergonomie – de la conception QWERTY et les nombreuses études entreprises en vue de déterminer la fatigue de l'opérateur, le layout du clavier et la position de travail, il est probable que le clavier QWERTY restera encore la norme fondamentale pour bien des années.

Caractéristiques physiques des claviers

Les principales caractéristiques physiques d'un clavier incluent la force requise pour presser les touches, la grandeur des diverses touches et leur espacement l'une par rapport à l'autre. De toutes ces caractéristiques, ce sont probablement la grandeur des touches et leur espacement qui ont la plus forte influence sur la fréquence des erreurs de frappe. A l'encontre de ce qui se passe avec les claviers de machines à écrire et les claviers des vieilles machines TTS, ni la course des touches, ni la force à exercer sur les touches ne sont spécialement dignes d'attention dans le cas des terminaux électroniques. Et il est improbable que ces deux caractéristiques aient une influence notable sur le rendement de l'opérateur.

En se basant sur les résultats d'études entreprises par des fabricants et des ergonomistes, on peut conclure qu'il existe vraisemblablement une combinaison optimale des caractéristiques d'un clavier. Et, compte tenu des différences entre lesdits résultats, on peut tenir pour acceptables les caractéristiques données dans le tableau suivant:

force sur les touches:	25 à 150 g
course des touches:	1 à 4 mm
forme des touches:	carrée
grandeur des touches:	12,5 mm
espacement des touches:	3 à 6 mm
espacement des centres:	16 à 19 mm

On a également découvert ceci: si l'angle des touches par rapport à l'horizontale ou si leur disposition sur le clavier empêche l'opérateur de taper son texte avec les avant-bras à l'horizontale, il se produit rapidement des sensations de fatigue.

CARACTERISTIQUES DES ECRANS

Couleur de l'écran

La couleur du fond d'un écran d'affichage est déterminée par les caractéristiques d'émission de la couche de phosphore appliquée sur la surface intérieure de l'écran. Les propriétés de rémanence de plusieurs des phosphores les plus utilisés pour les tubes cathodiques sont décrites dans le chapitre traitant la régénération des caractères.

Pour ce qui concerne la lisibilité, l'acuité optique de l'oeil humain est la plus élevée dans la partie jaune/vert du spectre. Joint au fait que l'un des phosphores préférés à faible fluorescence rémanente transmet une lumière maximale dans la partie verte, la première constatation a conduit à une préférence marquée pour la combinaison suivante: des caractères en jaune/vert sur un fond en vert plus foncé. Cette combinaison assure une bonne lisibilité des caractères et un bon contraste hors-tout. De plus, elle améliore la durée de vie du tube cathodique. Toutefois, les arguments contraires font valoir que le vert clair s'avère «dur» pour les yeux et qu'une combinaison noir/blanc permet une bonne lisibilité et un excellent contraste tout en réduisant la contrainte exercée sur les yeux par l'éblouissement. D'autres combinaisons de couleurs ont été choisies principalement pour cette même raison. Et les fabricants commercialisent maintenant une large gamme de combinaisons chromatiques telles que bleu/gris, vert/noir, orange/ambre, etc.

Puisque la lisibilité du texte et le risque de contrainte des yeux dépendent non seulement des seules couleurs, mais également de la relation entre écran et luminance

ambiante — et supposition faite que l'on élimine l'éblouissement —, il est probable que les préférences personnelles pour certaines combinaisons de couleurs l'emportent sur toutes les autres considérations purement optiques et chromatiques.

Luminance de l'écran

Les avantages ou inconvénients d'un fort contraste ou d'un faible contraste entre les luminosités — sur l'écran — des caractères et du fond doivent être considérés en relation avec le niveau d'éclairage hors-tout dans le local et au terminal à écran. Une luminosité trop réduite de l'écran rend les caractères difficiles à lire, tandis qu'un trop fort contraste peut promptement provoquer de l'éblouissement. Ainsi, quoique l'on recommande généralement de maintenir à une valeur réduite le rapport entre la luminosité des caractères et la luminosité du fond de l'écran, il existe un contraste optimal correspondant aux conditions d'éclairage ambiant au terminal à écran.

Afin de minimiser les risques d'inconfort dus à l'éblouissement du contraste, on a recommandé de ne pas excéder 3:1 en ce qui regarde le rapport des luminances entre les caractères et le fond de l'écran. De même, afin d'éviter des variations de contraste élevées et potentiellement gênantes dans le champ de vision périphérique de l'opérateur, on a proposé de prévoir un rapport de 3:1 à 5:1 entre la luminosité de l'écran et la luminosité de l'environnement. Bien qu'il soit peut-être difficile — dans la pratique — d'obtenir un rapport de luminance de 3:1 entre l'écran et l'environnement, on est arrivé à l'estimation suivante: dans le cas d'une luminosité moyenne de l'affichage d'environ 10 cd/m^2, il est possible d'arriver à une relation acceptable entre les luminances à condition que le niveau d'éclairage ambiant se situe entre 100 et 200 lux. Ceci constitue une valeur légèrement plus réduite que le niveau d'éclairage recommandé (300 lux) pour la rédaction et la lecture de textes dans l'environnement normal d'un bureau.

Comme directive pour le choix d'une luminosité adéquate des caractères, on a également suggéré que la valeur de luminosité à laquelle la plupart des collaborateurs lisent les textes en clair — soit environ 150 cd/m^2 — pourrait s'avérer acceptable, encore que toute valeur aux environs de 80 cd/m^2 se révélerait pareillement suffisante. Pour des bureaux largement éclairés, 150 cd/m^2 pourrait être tenus pour une valeur minimale.

Taux de régénération des caractères

La perceptibilité du scintillement de l'écran dépend d'un grand nombre de facteurs, dont les plus importants sont la luminosité, la grandeur et la densité de l'affichage, la longueur d'onde de la lumière et l'âge de l'observateur. En règle générale, plus

l'affichage est lumineux, grand et dense, plus le scintillement est perceptible. Mais, lorsque nous devenons plus âgés et que notre acuité visuelle diminue progressivement, il en va de même en ce qui concerne notre aptitude à déceler des objets à scintillement rapide.

Il y a deux façons d'obtenir un écran exempt de scintillement:
1) en revêtant l'écran d'un phosphore à forte rémanence – un cas dans lequel on a découvert que des taux de régénération aussi réduits que 30 à 35 Hz s'avèrent suffisants pour éviter le scintillement ou
2) en utilisant un phosphore à faible rémanence et en s'appuyant sur un taux de régénération plus élevé (valeur typique: 50 à 60 Hz).

Pour produire la même luminosité moyenne des caractères, les phosphores à faible rémanence doivent être excités à une plus haute valeur de pointe de la luminosité que les phosphores à forte rémanence. Par conséquent, l'intensité lumineuse instantanée varie dans une large plage lorsqu'on emploie des phosphores à faible rémanence, et de là vient que l'on doit compter sur des taux de régénération élevés pour parer à la perception du scintillement.

Rémanence du phosphore		Fréquence critique de scintillement (Hz)		
		34,3 cd/m²	109,6 cd/m²	342,6 cd/m²
P1	25×10^{-3} jaune/vert	–	–	–
P4	60×10^{-6} blanc	35	41	47
P7	400×10^{-3} jaune/vert	32	38	43
P12	210×10^{-3} orange	25	29	32
P31	38×10^{-6} vert	37	44	51

La rémanence de quelques phosphores ordinaires pour dispositifs d'affichage à tube cathodique est indiquée dans le tableau ci-dessus avec des fréquences critiques de scintillement – empiriquement déterminées – pour différents taux de luminance de l'écran.

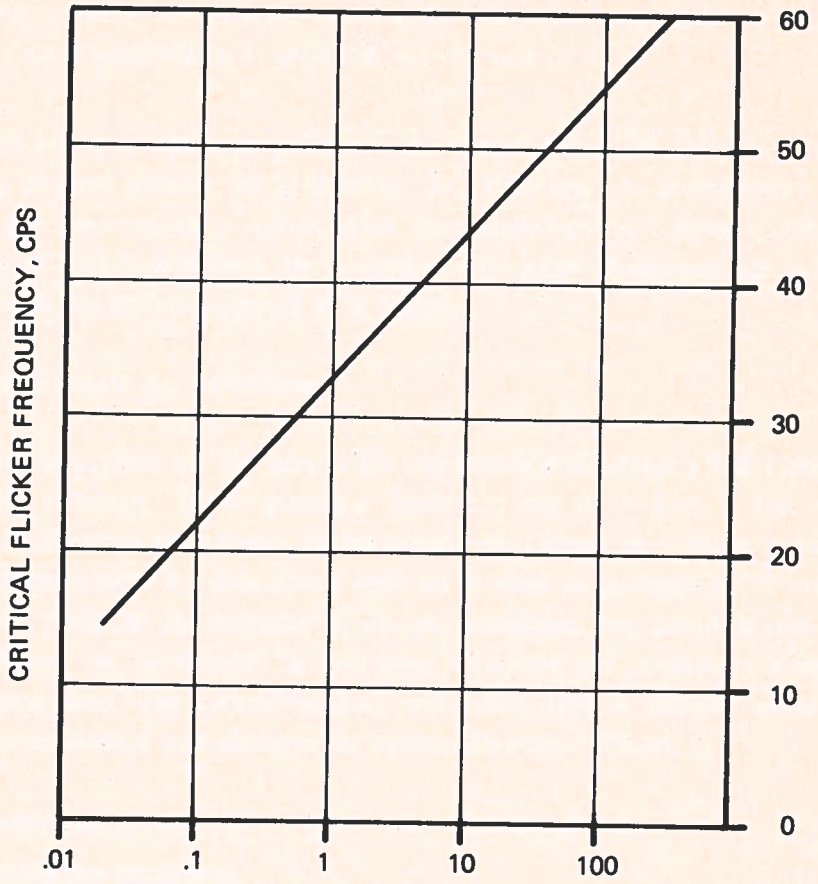

Figure 4: Variation de la fréquence critique de scintillement en fonction de la luminosité de l'écran.

Comme l'utilisation de phosphores à forte rémanence diminue usuellement la durée de vie des tubes, la plupart des fabricants préfèrent employer des phosphors à faible rémanence avec des taux de régénération de 50 Hz ou davantage.

AFFICHAGE DES INFORMATIONS

Génération des caractères

Sur l'écran d'un dispositif d'affichage, les caractères peuvent être formés par un arrangement de points ou de segments de lignes. Toutefois, dans les affichages alphanumériques, la technique la plus généralement utilisée est la génération des caractères à l'aide de matrices à points.

La lisibilité des caractères engendrés par une matrice à points dépend largement de la grosseur (nombre de points) de la matrice et de la grandeur hors-tout des caractères. Pour une grandeur de caractères donnée, plus le nombre de points dans la matrice est grand, plus les caractères apparaîtront lisibles et non déformés à l'opéra-

teur. Pour une grosseur de matrice donnée, la distorsion augmente et la lisibilité diminue avec l'accroissement de la grandeur des caractères.

Dans la mesure où la vitesse et la précision de l'identification des caractères peuvent être regardées comme mesure de la lisibilité de l'affichage, on a découvert que les signes formés par une matrice à points ronds sont supérieurs aux signes constitués de points allongés et que l'inclinaison des caractères a un effet désastreux sur la lisibilité des deux types de caractères (à point et à traits).

Grandeur et espacement des caractères

La lisibilité des caractères sur les écrans des dispositifs d'affichage a fait l'objet d'un certain nombre d'études. Et la grandeur optimale des caractères a été mise en relation avec la distance de lecture, la luminosité de l'écran et — dans le cas de la génération des caractères à l'aide d'une matrice — avec la grosseur de la matrice à points. Compte tenu de la complexité de ce problème, les résultats des études entreprises en vue de déterminer la grandeur optimale des caractères s'accordent remarquablement bien. Les caractéristiques indiquées dans le tableau suivant sont tenues pour acceptables à une distance de lecture d'environ 70 cm.

Hauteur minimale des caractères:	3,1 à 4,2 mm
Hauteur maximale des caractères pour matrice de 5 x 7 points:	4,5 mm
Rapport largeur/hauteur:	3/4 ou 4/5
Nombre minimal de lignes de trames:	10

Du point de vue de la lisibilité, la grandeur préférée des caractères augmente avec la luminosité décroissante de l'écran. Par ailleurs, des mots combinés avec majuscules et minuscules sont plus faciles à comprendre que les mots composés uniquement de majuscules ou de minuscules. Dans tous les cas, le temps de balayage d'un texte donné diminue avec la grandeur croissante des caractères. Et l'on a découvert que cela s'applique spécialement au temps de recherche pour les minuscules.

Capacité de l'écran

La capacité de l'écran a rapport au nombre d'espaces de caractères dont on dispose sur l'écran durant un affichage statique. La capacité effective du terminal peut être agrandie par l'incorporation de possibilités de mémorisation et d'appel. Dans un affichage statique, le nombre d'espaces disponibles de caractères varie usuellement de 800 à 1500, mais quelques terminaux sont offerts avec des capacités de l'écran atteignant 3000 caractères ou davantage.

La capacité optimale de l'écran dépend du genre des travaux effectués. Mais il peut s'avérer utile d'établir un rapport entre la capacité de l'écran et le contenu en mots d'un article de journal «typique». Là où l'on exige une capacité effective élevée de l'écran, on devrait attacher de l'attention aux possibilités de localisation par «enroulement» ou par «mise en page». La première méthode est particulièrement utile lors de la localisation et de la rédaction de volumes de textes relativement petits tels que des articles isolés. Toutefois, dans les cas où l'on doit faire fréquemment usage des possibilités d'appel et — particulièrement — où il faut balayer de larges volumes de textes, on donne le plus souvent la préférence à la «mise en page» parce qu'elle exerce une moindre contrainte sur les yeux et qu'elle réduit en outre le temps requis pour l'exploration de la mémoire.

Toutefois, la localisation à l'aide de cette méthode présente l'inconvénient de ne pas permettre le chevauchement entre — disons — le dernier paragraphe d'une page et le premier paragraphe de la page suivante. S'il est indispensable de traiter cette partie du texte, il peut s'avérer incommode de commuter vers l'arrière et l'avant pour lire et modifier le texte. Pour cette raison, il est souhaitable que les terminaux à écran destinés à la rédaction soient munis de systèmes jumelés pour l'enroulement et la mise en page.

On a également fait naître l'idée suivante: afin d'éviter des possibilités de distraction ou de désagrément, on devrait disposer de moyens adéquats pour supprimer le clignotement du curseur lorsqu'on ajuste les informations.

En général, les critères auxquels devrait répondre le curseur sont les suivants:

* il devrait être facilement localisable sur l'écran;
* on devrait pouvoir suivre aisément sa trace au travers de l'affichage;
* il ne devrait pas gêner la lecture du signe à masquer;
* on ne devrait pas utiliser pour le curseur une forme ou un signe déjà utilisés pour d'autres buts sur l'écran.

PLACES DE TRAVAIL AVEC TERMINAUX A ECRAN

Bien que la cause primaire des plaintes émises par les opérateurs de terminaux se rapporte à la contrainte des yeux et à des maux de tête qui — dans la plupart des cas — sont le résultat d'un éclairage défectueux ou de trop longues périodes d'observation directe de l'écran, le placement inadéquat de l'écran par rapport à l'opérateur peut donner naissance à des problèmes associés à une mauvaise position de travail. Des problèmes de cette nature — lesquels peuvent se traduire par des douleurs dans le cou, les épaules et le dos — ne sont pas chose inhabituelle parmi toutes les catégories d'employés de bureau qui doivent rester assis pendant de

longues périodes de temps dans une position demeurant essentiellement la même. Et, si l'on ne fait pas preuve de la prévoyance nécessaire lors de la sélection des équipements de bureaux et de la conception des places de travail, il faut s'attendre à ce que des plaintes de ce genre proviennent également des opérateurs de terminaux.

Equipement des bureaux

Une bonne position assise s'obtient avec une chaise et une hauteur de pupitre qui concordent parfaitement bien avec les caractéristiques physiques de la personne concernée. Donc, il est préférable que la hauteur de la chaise et la hauteur du pupitre soient réglables. Cela vaut spécialement dans le cas où les terminaux sont utilisés chacun par plus d'un opérateur sur la base d'équipes ou d'une rotation et où l'on devrait donc prévoir des tolérances appropriées pour les caractéristiques physiques différentes des opérateurs.

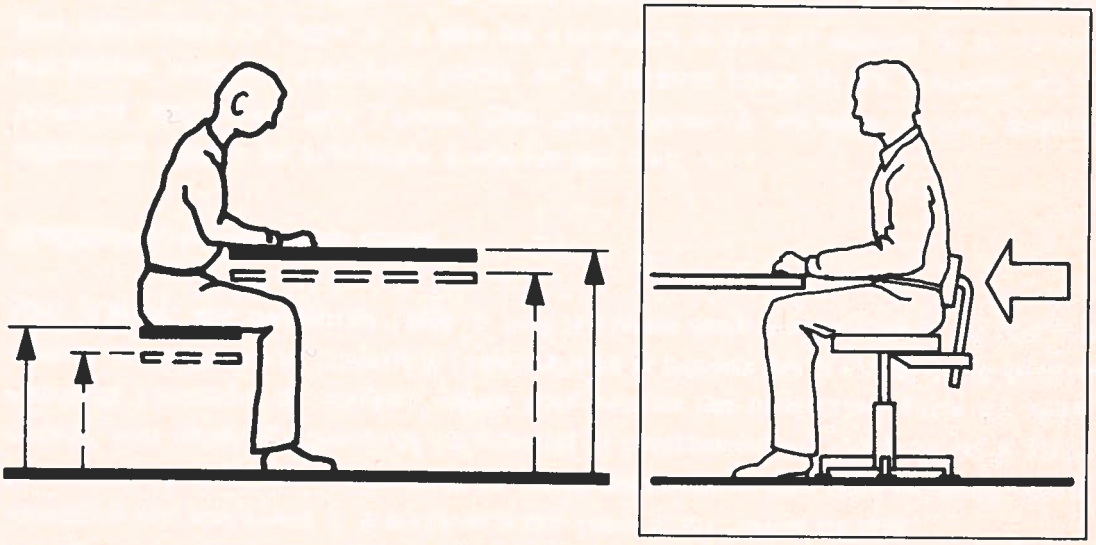

Figure 5: Quelques caractéristiques désirables des pupitres et des chaises pour places de travail équipées d'écrans (reproduction avec l'aimable autorisation de STANSAAB).

La plupart des types de chaises de bureau ordinairement commercialisées conviennent bien tant pour les opérateurs de terminaux que pour les autres collaborateurs. En général, les chaises pivotantes permettent un degré désirable de liberté de mouvement, mais elles devraient comprendre un dispositif de verrouillage afin d'assurer une stabilité adéquate durant la frappe. De plus, on a fait la suggestion suivante: afin d'encourager une bonne position assise, la hauteur des chaises devrait être ajustée de façon que les opérateurs puissent poser les deux pieds sur le sol sans avoir à contraindre les muscles et tendons des jambes. Les chaises devraient comporter une lunette afin de caler le bassin et de faciliter une position assise droite.

Enfin, quoique des roulettes rendent possible un degré additionnel de liberté de mouvement, il faut alors un effort physique distinct pour maintenir une position stationnaire. Pour cette raison, les roulettes ne conviennent pas à des chaises conçues pour maintes catégories de personnel de bureau, y compris les opérateurs de terminaux.

Les pupitres sur lesquels sont montés les terminaux à écran devraient être choisis en relation avec le travail à effectuer. Toutefois, une chose d'importance primordiale est de prévoir une surface appropriée des plateaux de pupitres pour pouvoir y placer les matériels auxiliaires tels que téléphones, appareils de télécommunication, copies, matériel d'écriture et même machines à écrire. Il convient de prévoir en outre des tiroirs, etc. pour que les opérateurs puissent y ranger leurs affaires personnelles qui — sans cela — encombreraient les plateaux des pupitres ou le plancher.

On a également fait la suggestion suivante: la hauteur convenable des pupitres devrait être déterminée de façon à ce que les opérateurs soient en mesure de se retenir eux-mêmes avec les avant-bras placés sur le pupitre lorsqu'ils s'y appuient en se penchant légèrement vers l'avant. Cela peut donner à entendre qu'une hauteur réglable de pupitre est préférable à une hauteur fixe.

Arrangement des places de travail

Afin d'éviter des problèmes reliés à une mauvaise position de travail, la position relative du terminal par rapport à l'opérateur et la hauteur de la chaise et du pupitre devraient s'accorder de manière idéale pour chacun des opérateurs. Dans cet ordre d'idées, une chose d'importance capitale est le positionnement du terminal à écran par rapport à la lumière disponible, car cette disposition a une forte influence sur la sensibilité des opérateurs à la contrainte des yeux et aux maux de tête.

Pour la plupart des applications dans une entreprise de journaux, il est sans doute préférable de placer le terminal directement en face de l'opérateur — cela de façon à ce que ce dernier puisse voir l'écran à un angle tel que les yeux regardent légèrement vers le bas. On facilite cette position en inclinant l'écran lui-même. Et il serait souhaitable que les fabricants se penchent sur cette question en allant même jusqu'à prévoir un angle d'inclinaison réglable pour l'écran.

Il est également désirable que les terminaux à écran soient équipés de dispositifs ad hoc pour le réglage de la hauteur du dispositif d'affichage et de sa position relative par rapport à l'opérateur. A cet effet, les fabricants ont mis au point plusieurs conceptions spéciales — par exemple, un dispositif de pivotement (quelquefois en combinaison avec un système à coulisse pour les plateaux des pupitres). En offrant ces possibilités, on évite le besoin d'une hauteur réglable des pupitres, tout en permettant aux opérateurs d'ajuster correctement l'emplacement de l'écran en relation avec leurs propres caractéristiques physiques.

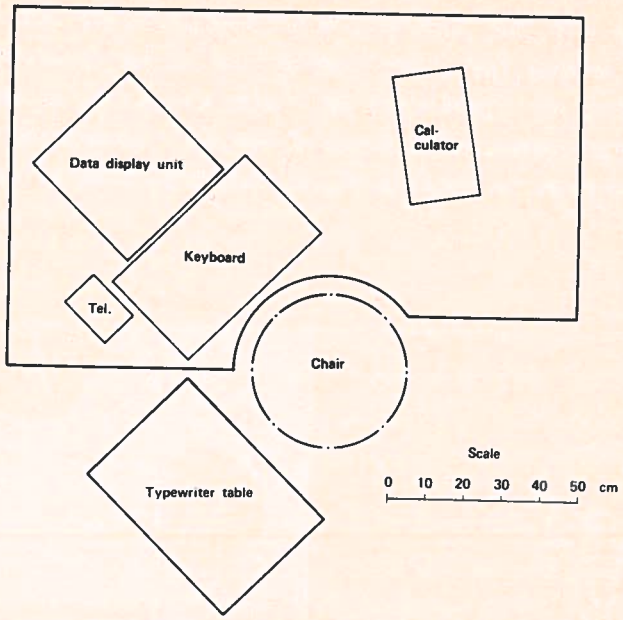

Figure 6: Layout typique d'une place de travail avec écran (reproduction avec l'aimable autorisation de STANSAAB).

Suivant le genre de travail à effectuer, les téléphones et autres accessoires tels que porte-copies, etc. devraient être placés de manière à éviter des mouvements inutiles. Le positionnement de la copie ou d'un porte-copies est optimal dès que l'opérateur ne doit plus bouger la tête latéralement ou vers le haut et le bas lorsqu'il consulte soit la copie, soit l'écran.

Eclairage de travail

Pour l'opérateur d'un terminal, un bon éclairage requiert un niveau d'illumination qui correspond aux besoins de la place de travail particulière.

Prenons l'exemple d'un opérateur qui doit visualiser sur l'écran des informations écrites à la main ou à la machine sur une copie. En ce cas, le niveau d'illumination requis ne doit pas empêcher tant la lecture de la copie que la perception visuelle des caractères affichés sur l'écran. Dans une situation de ce genre, il existe un niveau d'illumination optimal. Et les principaux facteurs à prendre en considération sont les suivants:

* la puissance de la source lumineuse,
* sa position relative par rapport aux yeux de l'opérateur,
* sa position relative par rapport à l'écran,
* la direction de la lumière du jour disponible.

La chose la plus importante consiste à parer à tout éblouissement, lequel peut résulter soit de la vue directe d'une source lumineuse, soit d'un trop fort éclairage provoquant des réflexions sur la surface de l'écran, soit encore de surfaces lumineuses placées dans le champ de vision de l'opérateur. Du point de vue de la construction, il est possible de minimiser le risque d'éblouissement en appliquant une couche antireflet sur le verre de l'écran ou en utilisant un verre non réfléchissant à faible éblouissement.

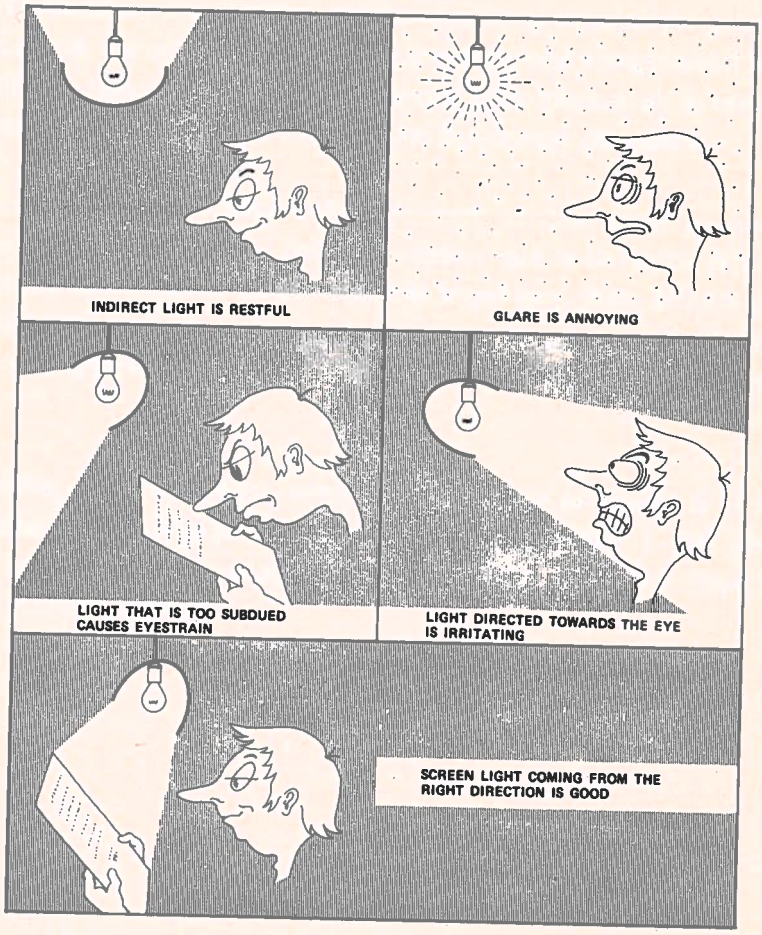

Figure 7: L'éblouissement est la cause la plus fréquente de sensations d'inconfort ressenties par les opérateurs de terminaux à écran. On devrait l'éliminer à tout prix (reproduction avec l'aimable autorisation de STANSAAB).

En règle générale, les exigences d'éclairage pour la lecture d'une copie lors du travail à l'écran devraient être légèrement plus réduites que celles pour la lecture de la copie seulement. La raison en est la suivante: tandis qu'un fort niveau d'illumination améliore la lisibilité des caractères (foncés) sur du papier (clair), c'est l'inverse qui se passe avec la lisibilité des caractères (clairs) sur le fond (sombre) de l'écran.

Par conséquent, le niveau d'illumination optimal à un terminal à écran est une question d'équilibre — c'est-à-dire qu'il s'agit de trouver l'équilibre adéquat pour assurer une lisibilité égale tant de la copie que des informations affichées sur l'écran.

En se basant sur le nombre limité d'études entreprises pour l'examen de cette question, il serait prématuré d'affirmer qu'un niveau d'illumination de tant et tant de lux s'avère optimal. Néanmoins, pour donner une idée des niveaux concernés, disons que l'on recommande une intensité lumineuse d'environ 150 lux comme celle qui — dans l'ensemble — se traduit par un équilibre acceptable entre la copie et l'écran du point de vue de l'optique. On peut établir une comparaison avec le niveau de 300 à 500 lux dans l'environnement normal d'un bureau et le niveau réduit de 50 lux avec lequel doivent parfois travailler les opérateurs de radars.

En raison de l'absence d'une règle universellement valable quant au niveau d'illumination absolu, il vaut peut-être la peine de répéter que la direction d'où provient ou semble apparaître la lumière joue un rôle très important. Pour sa plus grande partie, la lumière artificielle devrait provenir de la même direction que la lumière du jour disponible — tout particulièrement si la source lumineuse n'est pas protégée par un écran.

En règle générale, l'éblouissement cesse de devenir un problème si la source lumineuse est située dans un plan formant un angle supérieur à 30° par rapport à l'horizontale. Mais il importe vraiment que la lumière atteignant l'opérateur soit si possible de la lumière réfléchie.

CHECK-LIST

Sélection de l'équipement

Lisibilité

Il convient d'attacher une importance particulière à la lisibilité de l'affichage. Des caractères formés à l'aide d'une matrice à points circulaires peuvent s'avérer préférables à ceux formés à l'aide d'une matrice à traits inclinés ou à points allongés. Pour assurer une lecture commode à la distance de travail normale, les différents caractères devraient avoir un contour net et un espacement convenable. Une matrice de 5 x 7 points peut être considérée comme une définition minimale, bien que l'augmentation de la grosseur (nombre de points) de la matrice améliore considérablement la lisibilité.

Luminosité

Afin de minimiser le risque d'éblouissement, le rapport des luminosités (contraste) entre les caractères et le fond de l'écran devrait se situer à environ 3:1. De même, le contraste entre l'affichage et l'environnement devrait former un rapport d'environ 3:1. Selon le niveau d'illumination ambiante, une luminosité des caractères entre environ 80 et 150 cd/m^2 peut être tenue pour acceptable. Pour éviter des réductions inutiles de la durée de vie des tubes cathodiques, il est désirable que ces derniers atteignent ces valeurs à un point en dessous du rendement maximal.

Taux de régénération

Le taux de régénération devrait être suffisamment élevé afin d'éviter la perception du scintillement. Pour la plupart des phosphores à faible rémanence généralement utilisés, un taux de régénération de 50 Hz peut passer pour acceptable.

Couleur de l'écran

Les couleurs de l'écran devraient être choisies sur la base d'une bonne lisibilité. Comme un contraste hors-tout des luminances est plus important qu'un contraste des couleurs, il est probable que les préférences personnelles quant aux combinaisons de couleurs l'emportent sur des considérations purement optiques.

Localisation

Lors de la sélection d'un équipement pour une application de rédaction, il faut faire bien attention à la capacité adéquate de mémorisation et à des possibilités de localisation des informations. Dans la plupart des cas, des possibilités jumelées de localisation par «enroulement» ou par «mise en page» sont préférables à la localisation par la première ou la deuxième méthode seulement.

Environnement

En sélectionnant un équipement comprenant des terminaux destinés à une utilisation fréquente, il convient de considérer l'émission de chaleur en relation avec la fiabilité opérationnelle des matériels. Ni le bruit, ni l'émission de chaleur ne peuvent être tenues pour problématiques.

Eclairage des places de travail

Eclairage ambiant

Le niveau d'illumination hors-tout des bureaux se situe usuellement entre 300 et 1000 lux. Dans un centre de terminaux à écran, le niveau d'illumination devrait permettre une lecture aisée tant de l'affichage que des documents additionnels (par exemple des copies). Avec des luminosités typiques de l'écran, un niveau d'illumination ambiante de 100 à 300 lux peut passer pour acceptable.

Eclairage local

Pour tenir compte des différences individuelles quant à l'âge et à l'acuité visuelle, on devrait prévoir un éclairage local à chaque place de travail. Cette source lumineuse additionnelle devrait être placée de manière à éviter un éblouissement direct et/ou des réflexions sur l'écran.

Protection contre l'éblouissement

Puisque l'éblouissement constitue l'un des plus importants facteurs susceptibles d'influencer les probabilités d'inconfort des opérateurs, il faut prendre toutes les mesures nécessaires pour éliminer l'éblouissement provenant des fenêtres et des sources de lumière artificielle. Toutes ces dernières devraient être munies d'écrans ad hoc — cela de façon à ce que la lumière qui parvient à l'opérateur soit si possible de la lumière réfléchie. De même, il convient d'installer des stores ou des rideaux à toutes les fenêtres ou à toutes les autres surfaces hautement réfléchissantes. Pour réduire encore davantage le risque d'éblouissement, les terminaux devraient être placés de manière à ce que les opérateurs ne se trouvent pas en face d'une fenêtre ou d'une source lumineuse non munie d'un écran.

Possibilités de repos

Règle générale: plus le travail dure longtemps, plus nous sommes enclins à éprouver des sensations de fatigue et moins nous sommes capables de travailler bien. Dans toutes les formes de travail supposant une vision précise — et le travail à des terminaux à écran doit être compris dans cette catégorie —, on devrait éviter de trop longues périodes ininterrompues de vision. Pour des activités intermittentes à l'écran, il n'est pas spécialement nécessaire de prévoir des périodes spécifiques de repos. Mais, si l'opérateur passe la plus grande partie de son temps au terminal à écran, l'expérience a montré que des pauses de dix à quinze minutes — de préférence au milieu de la matinée et de l'après-midi — s'avèrent suffisantes pour parer à des sensations de contrainte et de fatigue.

Meubles de bureau

Quoique les considérations relatives à l'ameublement des bureaux puissent — en quelque sorte — paraître d'une importance secondaire pour ce qui est des exigences fonctionnelles de l'équipement, le besoin d'encourager une bonne position de travail constitue un aspect fort important que l'on ne devrait pas passer sous silence.

Pupitres et chaises

Dans le cas idéal, tant la hauteur des pupitres que la hauteur des chaises devraient être réglables afin de concorder avec les besoins des opérateurs. Cela joue un rôle d'autant plus important lorsque les terminaux sont utilisés par un certain nombre de personnes (travail en équipes ou par rotation). Dans le cas le plus fréquent d'une hauteur de pupitre fixée, la hauteur de la chaise devrait être ajustée de façon à permettre la frappe avec les avant-bras à l'horizontale. Les pieds devraient reposer sur le sol avec les jambes placées dans une position plus ou moins à l'équerre par rapport au sol. Si cela ne peut se faire sans allongement des jambes, il convient de prévoir un support pour les pieds.

La plupart des types de chaises de bureau conviennent aux terminaux à écran — à condition toutefois qu'elles soient du type avec couronne pour le maintien du bassin. Les chaises pivotantes assurent une liberté de mouvement désirable, mais on devrait pouvoir les bloquer dans une position déterminée (meilleure stabilité lors de la frappe). En général, les chaises avec roulettes ne sont pas appropriées pour cette application.

Conception des places de travail

Lors de la conception des places de travail, il est recommandable de prévoir un emplacement adéquat pour les téléphones, les appareils de télécommunication, les machines à écrire, etc. Par ailleurs, l'opérateur devrait pouvoir ranger ses affaires personnelles — par exemple, dans des tiroirs — afin de ne pas encombrer le plancher ou le plateau du pupitre.

Positionnement des terminaux

Dans la plupart des cas, il est préférable de placer chaque terminal à écran directement en face de l'opérateur et à une distance de vision adéquate. Un plateau de pupitre à coulisse permet à l'opérateur l'ajustage de la distance de vision la mieux appropriée dans son cas particulier.

Tests visuels

Des défauts de l'oeil chez les opérateurs de terminaux constituent une évidente source potentielle d'inconfort. Maintes personnes autorisées sont d'avis que le contrôle de la vision en vue de déceler des anomalies telles que myopie, astigmatisme, etc. s'avère souhaitable pour les collaborateurs travaillant à des dispositifs d'affichage.

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THE PUZZLE OF 0.7 AND SOME OTHER ISSUES OF RATIO SCALING

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THE PUZZLE OF 0.7 AND SOME OTHER ISSUES OF RATIO SCALING

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It is argued that internal consistency tests of subjective ratio scales are important for the understanding of the estimation processes on which the scales are erected. It is pointed out, with some empirical illustrations, that subjective ratio scales have their largest deviations from consistency around the level of 0.7 (in scales that range from 0.0 to 1.0). Interesting is that at the same level uncertainty data have their peaks. Some connections between these outcomes are discussed together with four models. The paper is concluded with some comments on the instrument-view of man, stressing that man in contrast to ordinary instruments represents rather than presents perceptual phenomena.

Introduction

The question whether direct ratio estimation methods give rise to scales with true ratio properties has been given contradictory answers in the literature. Mostly, the answer has been given in the affirmative, mainly due to the work of S.S. Stevens with its enormous impact in the area in the last two decades. Those who have pointed to the deviations in the scales from true ratio properties have been rather few and non-influencial.

Stevens and his successors in scaling have based their opinion on two facts. The first is that if "A" is a physical scale with ratio properties and "B", a corresponding subjective scale, is a simple power function of "A", i.e. $B = A^n$, then "B" is also a ratio scale. The "B"-scale keeps the ratio properties of "A" invariant, the only possible difference being the absolute size of the ratios. Now, it is the case that when direct ratio estimation or ratio production techniques are applied it is generally held that the subjective scale is a power function of the physical scale. In fact, it has been argued that this is the most validated law of all in psychology (Ekman & Sjöberg, 1965). Hence, there seems to be abundant evidence that the ratio scaling techniques give rise to subjective scales with ratio properties.

The other argument used by Stevens to validate his view on ratio scaling is that "cross-modal matchings" (see e.g. Stevens 1961; Stevens & Greenbaum 1966) result in consistent nets among the subjective scales. The cross-modal matching technique implies the simultaneous use of, and comparison between, two or more subjective scales. Hence, if in addition to the example above, the following relation holds, $C = A^m$, where C is another subjective scale, then from the cross-modal matching paradigm it is predicted that $C = B^{m/n}$, if the perception of C is to be expressed in terms of B. In a number of studies, this prediction is held to be corroborated (e.g. Stevens 1961, op cit.). Consequently, these outcomes suggest that, in addition to the ratio properties of the scales obtained, the exponents are non-arbitrary and constant over various conditions.

Further evidence and justification of Stevens "power law" have been drawn from the fact that the variability of the ratio estimates in ratio scaling is log-normal (Stevens & Guirao, 1962), that identical power laws have been derived from physiological data (e.g. Borg et al., 1967), that the sizes of the exponents for various continua may be predicted from simple half-settings (Eisler, 1975); from Teghtsoonian's (1971) and Borg's (1972) models, positing a constant general perceptual range, in terms of which the parameters of the power functions get their rationales. Indeed, the evidence for the power law is impressive.

As from any other natural law some deviations from the power law have been reported, but most of them have got some reasonable explanations. To take some examples, deviations from the power law at extreme low and high levels have been explained in terms of "threshold-effects" and by extending the simple power law with additive constants, e.g. $B = a + cA^n$ or any similar transformation, the power law may still be regarded valid. Non-linear relations to category scales have been explained in terms of "end-effects" that bias the category scales (as well as other partition scales) and the scales erected from direct ratio scaling methods may still be regarded as the true genotypical subjective scale. Inconsistencies in cross-modal matchings are said to be due to regression-effects, that are bound to occur in non-perfect data, etc. In effect, all these deviations are by Stevens and his collaborators held as minor idiosyncracies caused by occasional conditions that are inherent in any empirically derived scale which always can be corrected. In ideal conditions the power law would

hold true.

There is, however, a type of inconsistency not so easily disregarded. It is the internal inconsistency in the scales that is nearly always found when under scrutiny (see e.g. Eisler 1960; Mashour 1961; Sjöberg 1965; Hosman 1972; Hallsten 1971). The internal structure of the estimates may be studied whenever two or more stimuli within a set have the function of a standard stimulus. To take an example, if the magnitude of an object "X" is estimated to be 80 percent of that of an object "Y" and 40 percent of an object "Z", then we would expect object "Y" to be 50 percent of object "Z". Predictions like this one is however mostly rendered false. In most cases the predictions are too low. The obtained empirical estimates usually exceeds the predictions.

The internal structure of the estimates is a primary aspect of any obtained scale, in a sense exhibiting both its reliability and its validity. The fact is, however, that the ratio estimates are systematically inconsistent, unless some unusual assumptions are made (see Hallsten, 1975), for which no reasonable explanations have been given.

The neglect to examine the internal structure of the ratio estimates by Stevens and his collaborators is deplorable in view of the elasticity of the power function. The power function, with or without additive constants, can without much stress, be fitted to monotonically increasing functions with less demanding properties than the ratio scale. If inexplicable deviations are found in the psychophysical functions, then they are often held to be of a random nature. If taking pains to secure the internal structure of the estimates, which is a more sensitive approach than curve fitting in revealing deviations from a ratio scale, the conclusion reached must be a different one.

It is without doubt that ratio scaling procedures do not in general result in subjective scales with true ratio properties. From a practical point of view the deviations may be insignificant but, in a theoretical perspective, they may be of great importance. The hitherto presented and quite insufficient explanations for these deviations should be substituted by more sensible ones.

The fact that ratio scaling techniques do not yield true ratio scales is not to be regretted. No reasonable person would suggest that the estimates obtained by human subjects are generated in a similar way as those from an ordinary measuring device. These two processes are fundamentally different. What is of interest here is how the human subject generates his estimates, and the examination of the internal structure of the estimates may give valuable hints concerning this issue. The traditional instrument-view of man may also be revised in crucial respects and it is in this context the following study is to be seen.

The aim in this study is to present some experimental data that elucidates the inconsistency of ratio estimates and to suggest some models responsible for it. The paper is concluded with some comments on man as an instrument. To be able to outline the problem in some detail, some methodological considerations are first made.

Some general methodological considerations and an outline of the problem.

The internal structure of the ratio estimates has been tested by several techniques. One version implies the application of a special case of the psychophysical or the S-R plot. The estimates are her plotted against the corresponding ratios between the stimulus-values. Thereby, all stimulus-values are transformed into the numerical range between zero and one. The plots should then obey the equation $R = S^n$. One necessary consequence of this equation is that the plots depart from origo and reach the coordinate (1;1). The usual outcome is, however, that the plot must be extrapolated to a point above (1;1) (see e.g. Björkman & Strangert, 1960).

Another analytical tool is to calculate scale values for each stimulus which then can be used in various ways. The empirical estimates may then be plotted against derived ratios from the scale values, a procedure done e.g. by Mashour (1961 op cit.). Another possibility is to calculate separate scale values for stimuli in standard and variable stimulus positions and study their relative sizes, so called "v/s-ratios", as has been recommended by Sjöberg (1965 op cit.).

Hosman (op cit.) has shown that each analytical approach presented has its peculiarities and drawbacks. If a consistent scale is exposed to a specific bias, then there is, of course, no general method that in any case can discover and truly describe the bias. What is of interest here is not the necessary indeterminacy but that all analytical tools applied tend to distort the bias in their own specific ways and that they can not distinguish different biases. What they describe is the inconsistency but not the bias. Those who have studied the internal structure of ratio estimates have often confounded the bias with the inconsistency pattern. According to Hosman, the most sensitive and versatile method to separate those two is the one originally suggested by Eisler (1960 op cit.) and later developed by Hosman (op cit.). The empirical estimates are there plotted against constructed estimates based on pairs of other ratio estimates, and this technique is here partly adhered to. When available, it is complemented with psychophysical functions that may give additional hints regarding the bias. The Eisler-Hosman approach is now to be delineated in some detail followed by our problem.

The point of departure is a matrix of ratio estimates (or ratio productions). In each cell a number is given, q_{ij}, representing the subjective magnitude of object "i" in comparision to object "j". The object "i" is in this case, a variable stimulus and object "j" a standard stimulus. If the variable stimulus is of greater magnitude than the standard stimulus, the estimates are called multiples. In the converse case, which is most common, the estimates are called fractions. Such a fractional matrix is seen in Table 1.

Due to the ratio scale demands the empirically obtained estimate can be constructed from other empirical estimates in the matrix, e.g.:

$$q_{ij_c} = q_{ik}/q_{jk} \qquad (i,j,k = 1,\ldots,n) \qquad (1)$$

i.e., by division of estimate q_{ik} by q_{jk}. Likewise, q_{ij} can be constructed from multiplications, e.g., $q_{ij_c} = q_{ik} \cdot q_{kj}$ or by some combinations of multiplications and divisions. If the estimates conform to a true ratio scale then the constructed estimates, q_{ij_c} correspond to the empirical values, q_{ij}. This construction-procedure constitute a test of the internal consistency of the estimates.

Table 1. Fractional estimates obtained from a ratio estimation technique for seven stimuli.

		STIMULI IN VARIABLE POSITION (i)						
		1	2	3	4	5	6	7
STIMULI IN STANDARD POSITION (j)	1	-	.795	.566	.372	.306	.180	.040
	2		-	.697	.527	.402	.263	.055
	3			-	.718	.643	.390	.091
	4				-	.840	.557	.130
	5					-	.690	.173
	6						-	.268
	7							-

When the constructed estimates are derived from equation eq. (1) in its full extension, the typical appearance of the internal consistency test is as is exhibited in Figure 1, which is based on the estimates in Table 1.

It is seen that the empirical values, on the average, exceed the constructed ones, i.e. the points are mostly to the left of the diagonal. This will be referred to as the "under-estimation" phenomenon. The deviations increase up to about 0.7 in terms of the empirical values, from where the deviations tend to diminish. This figure is an illustration to our problem. Why do empirical values exceed the constructed ones? Why is there a "knee" in the plot and why does this occur about the level of 0.7? To the under-estimation phenomenon some explanations have been presented and these are here briefly recapitulated.

Some explanations are but vague guesses about the cause of the bias, e.g. Eisler's (1960 op cit.) explanation in terms of "size-weight

illusion". Some other explanations are themselves nothing but descriptions of the inconsistency but from another angel or perspective, e.g. Sjöberg's (1965 op cit.) "v/s-ratios" and Hellström's (1977) "position or time error", "asymmetric attentive processes", themselves needing justification. Svensson's (1968) suggestion of the statistical regression effect as responsible for the inconsistency is better in this respect, but is on the whole insufficient in explicating the S-curve tendency in the psychophysical functions. Hosman (1972 op cit.) is an exception in trying to elaborate or to present rationales for the hypotheses put forth, i.e. in connecting the inconsistency to idiosyncratic "number behavior" or to different detection thresholds for different stimuli in an extension of Fagot and Stewart's model (1968). Unfortunately, these attempts were rather unsuccessful. The same goes for Hallsten's (1975) hypothesis relating the inconsistency to an incorrect manipulation of credible intervals.

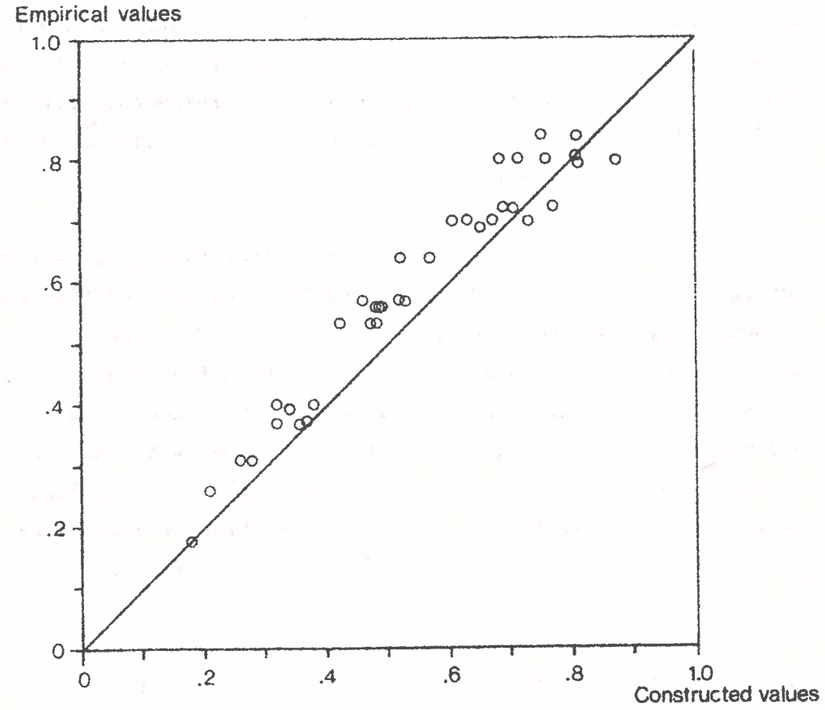


Figure 1. An internal consistency test based on the data from Table 1. The constructed values, q_{ij_c}, on the abscissa are derived from formula (1) and they are plotted against the corresponding empirical values, q_{ij}.

The important fact is that none of the explanations offered to the under-estimation phenomenon has rendered it conceivable. The processes referred to have not been elaborated at the single-trial level, which is indispensable to be classified as an efficient cause of the inconsistency. Regarding the knees at about 0.7 in the inconsistency pattern there have been no explanations whatsoever. The intention here is to fill this vacuum to some degree.

Some empirical data

Empirical data from three experiments is here to be used to elucidate our problem. The first set of data refers to an experiment where twenty subjects estimated the lengths of six lines in each possible combination. The complete ratio estimation technique was applied, i.e., both fractional and multiple estimates were obtained. Each subject estimated each pair of stimuli four times. The data here to follow are the geometric means of the individual estimates, and they are, in essential respects, representative of the individual outcomes. The experiment has been fully described in an earlier paper (Hallsten, 1971).

This set of data is adequate for the problem from two aspects. Firstly, the continuum of line length does not usually need any additive constants in the power function when plotted against stimulus-values. This facilitates the fitting of the function. Secondly, both fractional and multiple estimates are available. This is advantageous since they jointly can hint at possible idiosyncratic "number behavior" in the estimation process. If the multiple and the fractional estimates give the same results, then they may support the hypothesis that there are true perceptual causes for the outcome. If they show different outcomes it suggests that a certain "number behavior" has distorted the estimates.

The internal structure for the fractional and the multiple estimates is here separately presented. In Figure 2 the original S-R plots are seen for the fractional and inverted multiple estimates (to get the fractions and the multiples directly comparable). In Figure 3 the fractions are plotted against the best fitting power function of the type $q = S^n$ (for the inverted multiples, see Figure 2 b) and in Figure 4 the inconsistency

pattern is described.

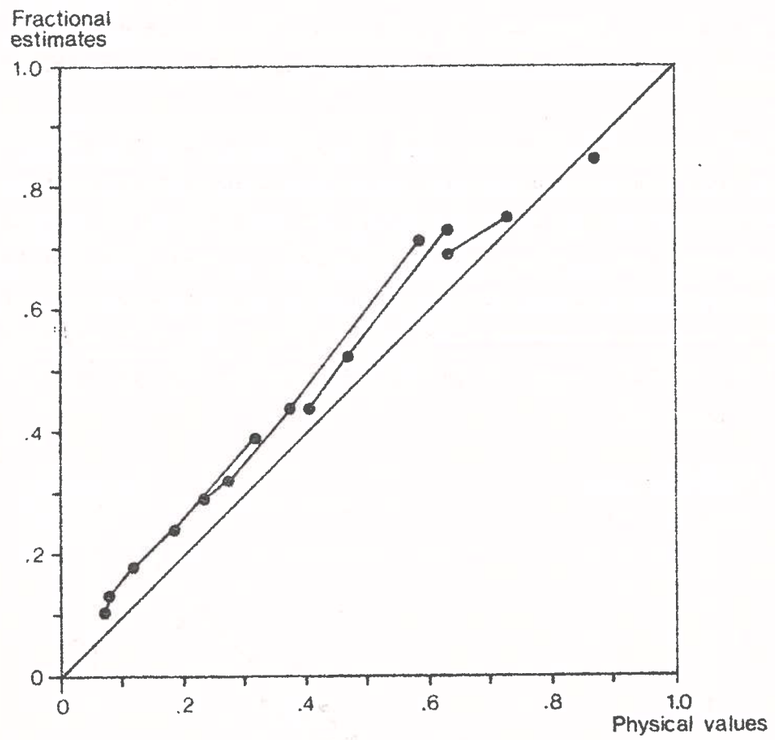


Figure 2 a. Fractional estimates from the line length experiment plotted against the corresponding stimulus ratios (S_i/S_j). Estimates from the same row are connected by lines.

Regarding the S-R plots, it can be seen that there are some knees around the ordinal value of 0.7 both for the fractions and for the multiples. The knee for the fractions is somewhat more pronounced. The best fit for a simple power function of the type $q_{ij} = (S_i/S_j)^n$ results in an exponent of 0.89 for the fractions and of 1.00 for the multiples. These fittings can be executed without much stress but they are basically incorrect. In fact, the functions are S-curved and most obviously for the multiples. By and large, the inconsistency pattern for the fractions can be traced to the three points at the knee but otherwise the estimates conform to

the simple power function. The corresponding fit for the multiplies is somewhat worse and the inconsitency pattern is here due to a more complicated interaction. Regarding the numerical level of the estimates, it is noted that the inverted multiples are in general lower than the fractions.

The appearance of the knees for both the fractions and the multiples suggests some similar causual processes behind the estimates, probably of a perceptual nature. On the other hand, the differences in numerical level indicate some biasing "number behavior" at work. The last hypothesis is also supported by the different trends in v/s-ratios for the fractions and the multiples. They were 0.88, 0.91, 0.95, 0.98, 0.99 and 1.02, 1.01, 1.05, 1.01 and 0.98 respectively (for the combined matrix: 0.91, 0.96, 1.00 1.01 and 0.99).

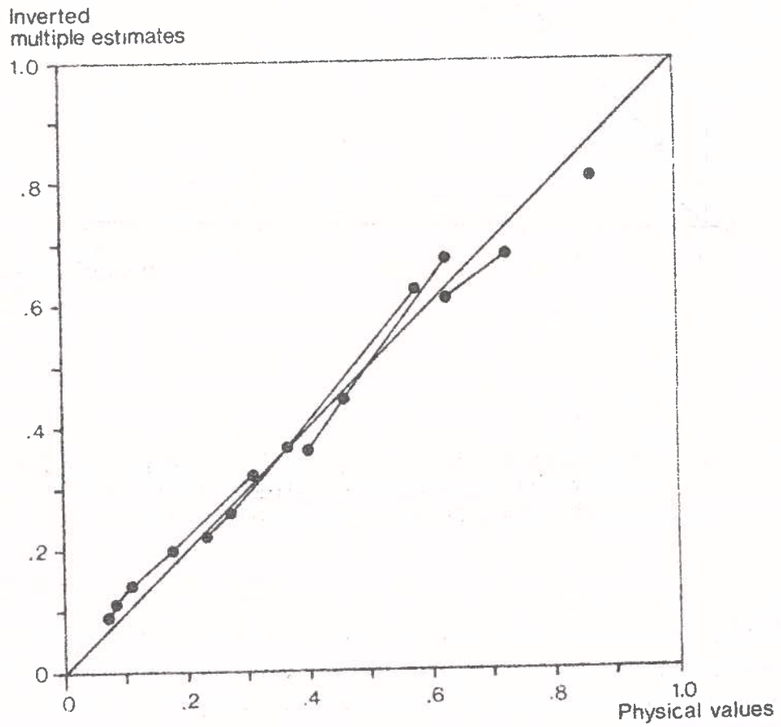


Figure 2 b. Inverted multiple estimates from the line length experiment plotted against the corresponding stimulus ratios (S_i/S_j). Estimates from the same row are connected by lines.

In the inconsistency plots it is seen that these knees are still present, but on different levels in comparison to the diagonal. The multiples are less inconsistent than the fractions ($\Sigma\, d^2 = 0.060$ and 0.073 respectively). It is to be noted that the typical underestimation structure between the empirical and the constructed values is recurring for the fractions but not as obviously for the multiples, where overestimations are typical at some levels. It is further noted that the inconsistency is not so large in an absolute level. This is also indicated by the v/s-ratios which oscillate around 1.0. The puzzling knees also emerged in this experiment. Are such knees to be found in other types of data? We will now turn our interest to some indices of uncertainty.

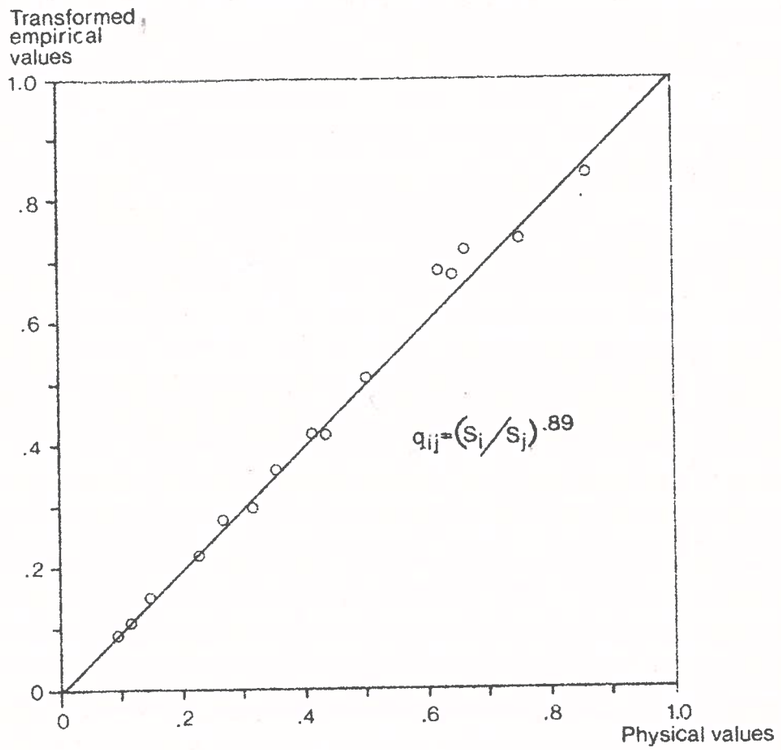


Figure 3. The best fitting power function, of the type $q_{ij}=(S_i/S_j)^n$, for the fractional estimates in Figure 2 a according to a least square criterium.

It is a common procedure to plot the standard deviation of the estimates against the estimates themselves. It is usually theorized that the uncertainty should be a linear function of the estimates, i.e. $s_r = kR$, "Ekman's law" as it has been called (Teghtsoonian 1971 op cit.). We shall pay some attention to this uncertainty function obtained in our line length experiment. In addition to the "point estimates" to which the data referred above, the subjects were required to provide "credible intervals", i.e., they should provide, to each pair of stimuli, an interval within which they were practically quite certain that the "correct" answer would lie. Consequently, in each trial the subjects gave three responses, a point estimate concerning "the most appropriate answer", and a lower and an upper bound estimate respectively including the correct answer according to their own criteria. The widths of these credible intervals may be used as an uncertainty index and we are to study them here.

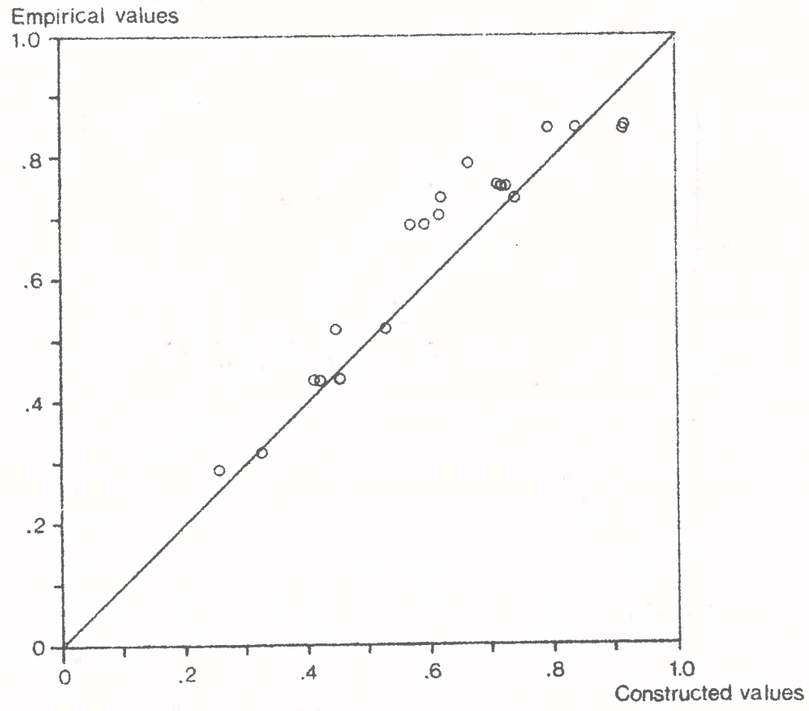


Figure 4 a. The inconsistency pattern for the fractional estimates in the line length experiment. The constructed values are derived from formula (1).

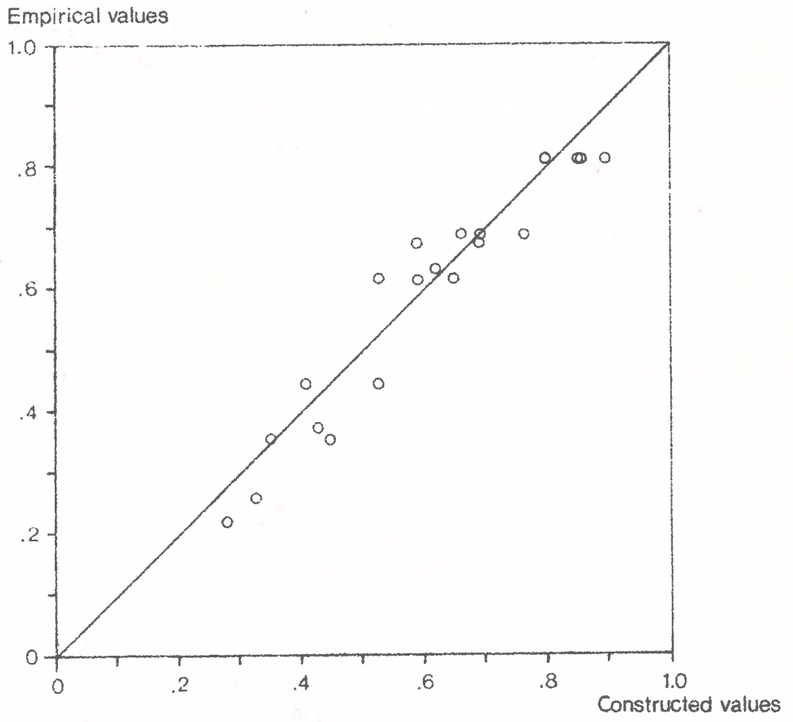


Figure 4 b. The inconsistency pattern for the inverted multiple estimates in the line length experiment. The constructed values are derived from formula (1).

In Figure 5 a the widths of the credible intervals for fractions and for the inverted multiples are presented. It is seen that both functions have a peak at 0.7, while the absolute level of the widths are somewhat larger for the fractions. The bend of these functions are rather expected as it is well known that subjects tend to be more certain at estimates around reference values. What is more interesting is that the knees occur at the 0.7-level and the possibility of some connection between the inconsistency pattern and the uncertainty index is left open.

Concerning the standard deviations for the fractions (those for the multiples were not obtainable at the moment) it is seen in Figure 5 b that they have their peak at a level just above 0.5 (.54 is the calculated value) and it is possible that the credible intervals are more related to, and have more in common with the point estimates than the

standard deviations. On the other hand there is abundant evidence from the literature (see e.g. Eisler 1957; Eisler & Montgomery 1974; Ekman 1957; John 1971) that the standard deviations or similar measures have their knees displaced upwards on the subjective scales around 0.7. The level of 0.7 seems to play an important role in ratio estimates.

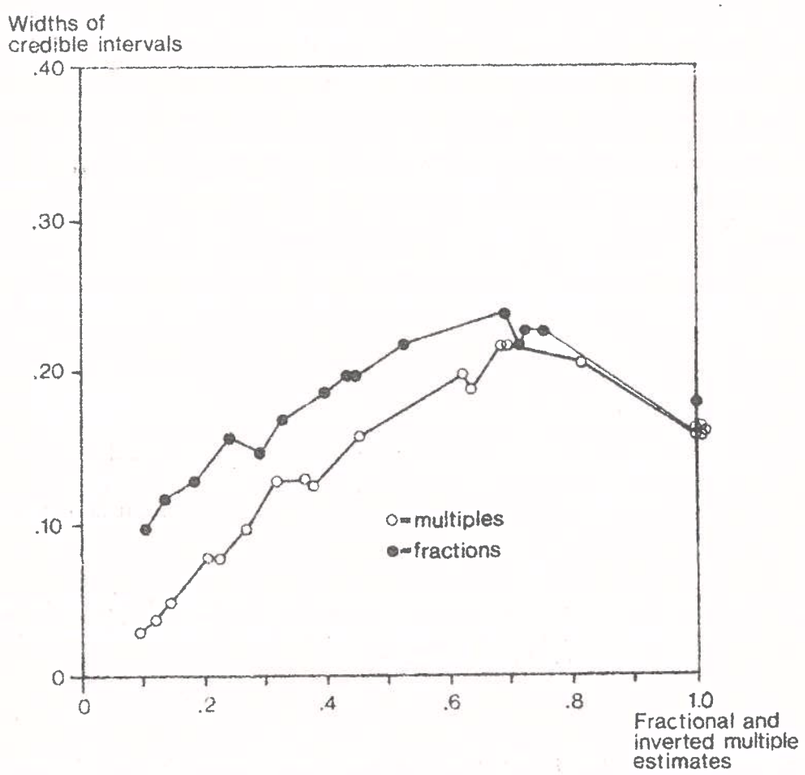


Figure 5 a. The widths of credible intervals as functions of the fractional and inverted multiple estimates from the line length experiment.

The next set of data is derived from a rather unusual ratio scaling experiment. Eleven psychologists with some experience of ratio scaling procedures estimated the perceived age of hypothetical persons, only described in a general conceptual manner. The seven "stimuli" used, numbered from one to seven, were "an old Pope", "and elderly man", "a middle-aged woman", "a young member of Parliament", a young housewife", "a teen-ager" and "a little child". The subjects were to estimate each

pair of stimuli in combination responding with the perceived age of the younger person in per cent of that of the older one. The one they perceived to be older should also be stated. Each subject estimated each combination once.

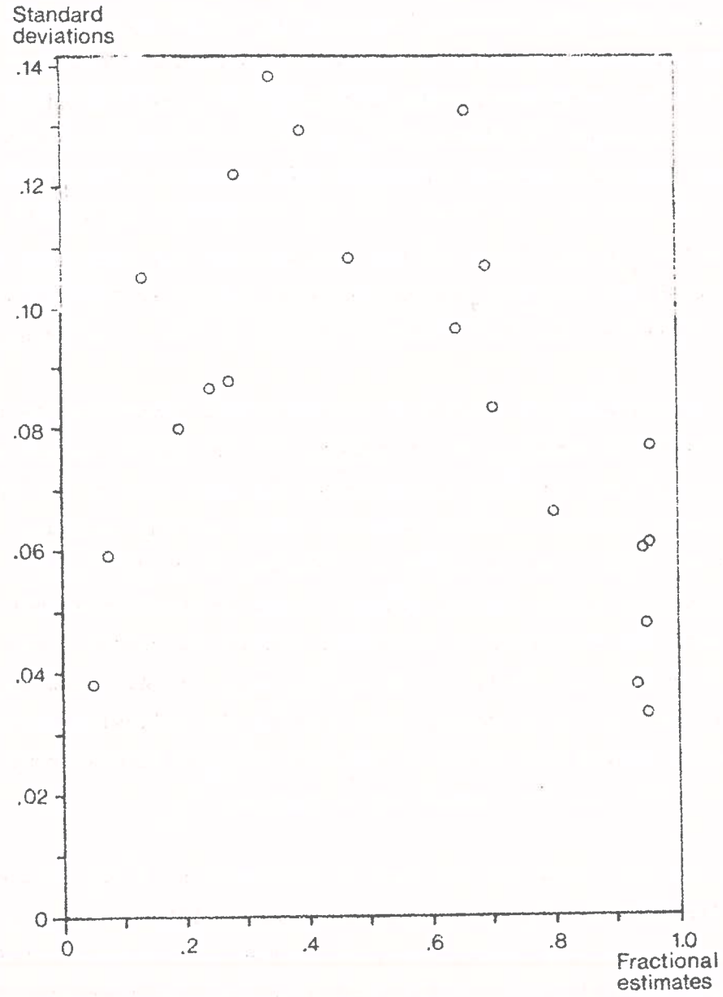


Figure 5 b. The standard deviations of the fractional estimates as a function of the fractional estimates. Data from the line length experiment.

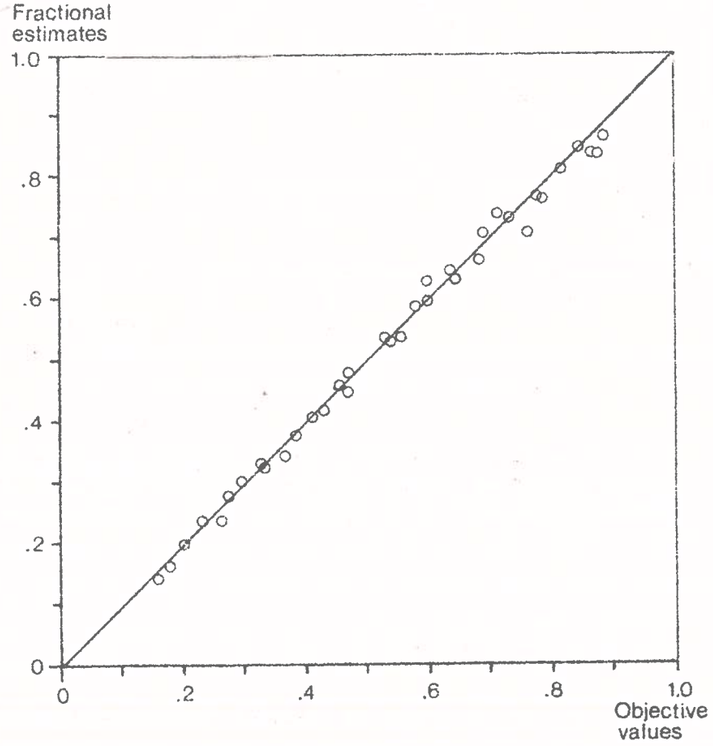
The aim of this experiment was twofold. The first one was to study if the subjects on the whole would accept the task of giving ratio estimates of these pairs of stimuli since the stimuli by definition must be quite vague with "penumbras" at their borders. The second aim was to see whether the usual type of inconsistency would appear or not. This would then suggest that the cause of the inconsistency is not to be looked for in any sensory dimension but rather in a cognitive one.

Regarding the first question it was quite clear that the subjects did not hesitate more than they normally would in any other scaling context. They gave their estimates as ordinary obedient subjects. Any definite sensory basis seems then to be unnecessary for subjects to provide direct ratio estimates. The result is shown in Table 1 with the inconsistency pattern in Figure 1. This is based on the geometrical means of the individual estimates for each pair of stimuli. It is, of course, impossible to carry out a S-R plot here. It can be seen that the same knee appears to the left of the diagonal around the level of 0.7 in the ordinate. A cognitive cause for the inconsistency pattern is then clearly suggested.

Our final empirical study refers to an experiment regarding the perceived relations between pairs of numbers. Twelve psychologists gave both fractional and multiple estimates of the magnitude of ratios between pairs of numbers, i.e., a complete ratio scaling procedure. For each pair of stimuli one estimate was obtained from each subject. The stimuli were all uneven numbers between 3 and 19 in all possible combinations (with the exception of identical numbers in standard and variable stimulus position). The geometric means of all these estimates were calculated and these values were used in the following analysis. The rationale behind this study is obvious. Can the inconsistency found be traced to the perceived magnitude of numbers?

The result of this study can be seen in Figures 6 to 8. In Figure 6 a and 6 b, the fractional and multiple estimates are related to the true objective magnitudes. The overall picture is that the estimates follow rather closely the diagonal and by and large they are consistent. In any case, the deviation from simple power functions is insignificant compared to those found for other continua examined. There are, however, some asymmetric deviating tendencies for the fractional and multiple estimates

as can be seen in Figure 7 where they have been plotted against each other. It can also be seen that the fractions are somewhat higher in the neighbourhood of 0.7 while the multiples exceed the fractions from 0.8 and above. Of interest here is that the outcome is at variance with the data in the length line experiment where both the fractions and the multiples had a knee around 0.7. Here it is only, at best, valid for the fractions, and this knee is hardly discernible. The typical inconsistency pattern is neither obtained when all total predictions are plotted against the empirical values. (Since the number of points is so large (82) they are not supplied here.) When the plot for the six smallest stimuli is selected, however, (which corresponds to the usual size of a ratio scaling experiment) then the usual pattern emerges, as it is conveyed in Figure 8, for the fractions. Consequently, it may make a difference from which numerical level the estimates are derived when the inconsistency pattern is studied.



igure 6 a. Fractional estimates of the magnitude of ratios between pairs of uneven numbers. Data refers to the geometrical means from twelve subjects.

The conclusion to be drawn from this experiment is that the perceived magnitude of numbers is not the sole or crucial determinant of the inconsistencies found, even if some trends point towards that direction. There must exist other causes that augment the inconsistencies.

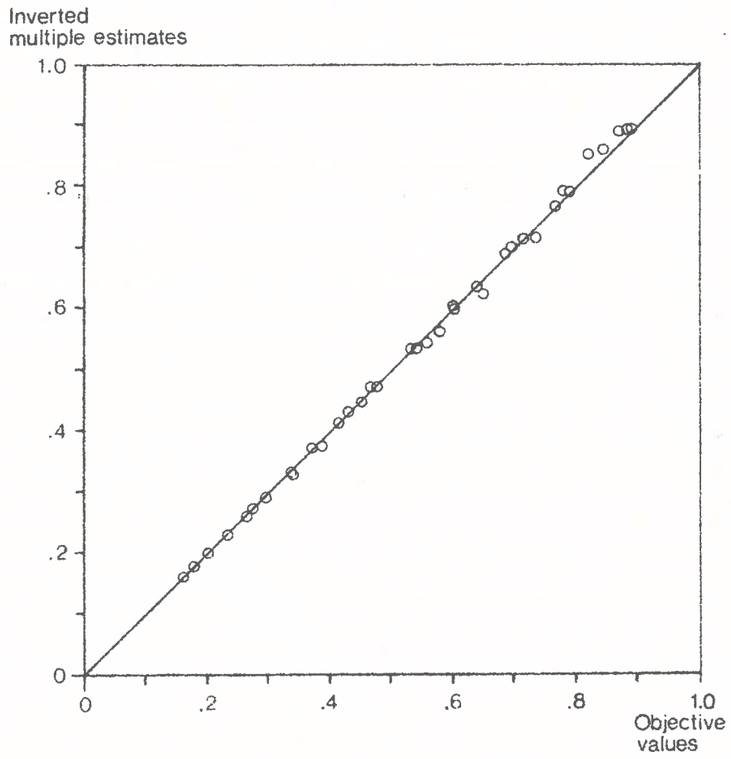


Figure 6 b. Inverted multiple estimates of the magnitude of ratios between pairs of uneven numbers. Geometrical means from twelve subjects.

Some explanatory attempts

Some explanations will now be given as regards the inconsistent ratio estimates. There are two facts to be focused on. First, the fact that the constructed values mostly underestimate the empirical values. Second, the knees found around the ordinate value of 0.7.

The explanations to be presented are such that they can be assumed to be operating at each single trial. We shall first address the underestimations of the empirical values.

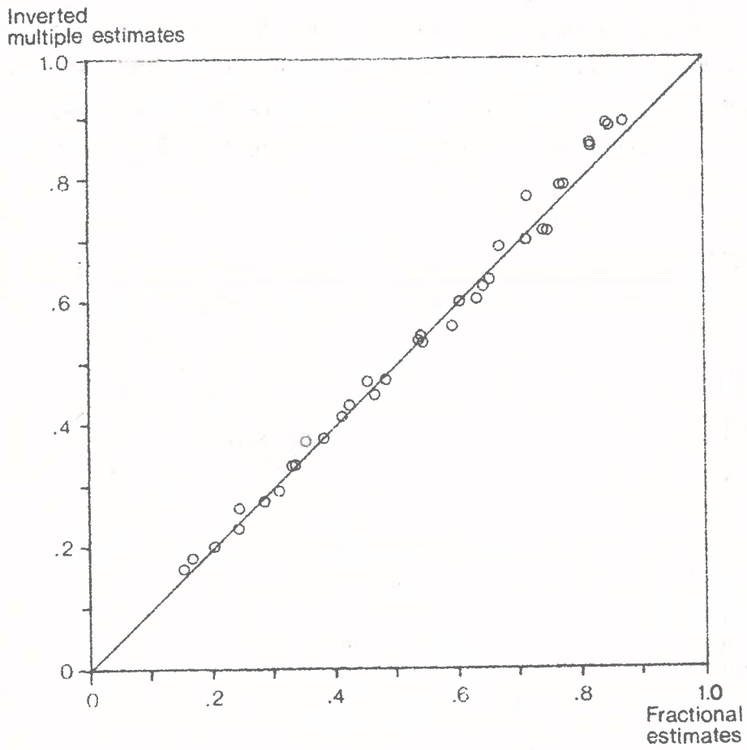


Figure 7. Inverted multiple estimates from figure 6 b plotted against the fractional estimates of figure 6 a.

The linear discriminator

This model assumes that the subjects attempt to discriminate the estimates as much as possible from each other. The maximization of sums of squared distances is carried out in linear terms and is applied to both columns and rows in the ratio matrix. As an example with six stimuli, the hypothetical subject would divide the continuum between 0 and 100 into six equal parts and he would try to keep this equality to contigous cells. Possible psychological rationales behind this strategy might be, in want of a true ratio scaling capacity, to use the response continuum in a uniform way and to show the strong discriminating power he possesses.

The outcome of such a strategy is exemplified in Figure 9. As a single explanatory model for the inconsistency phenomenon it is quite unsatisfactory, and in the present study it does not take care of the knees found. But the important thing to note is that such discriminating tendencies might lead to the under-estimation phenomenon. It has earlier been argued that subjective ratio estimates are a compromise between category and ratio scales, which would be the result if such discriminating tendencies were active.

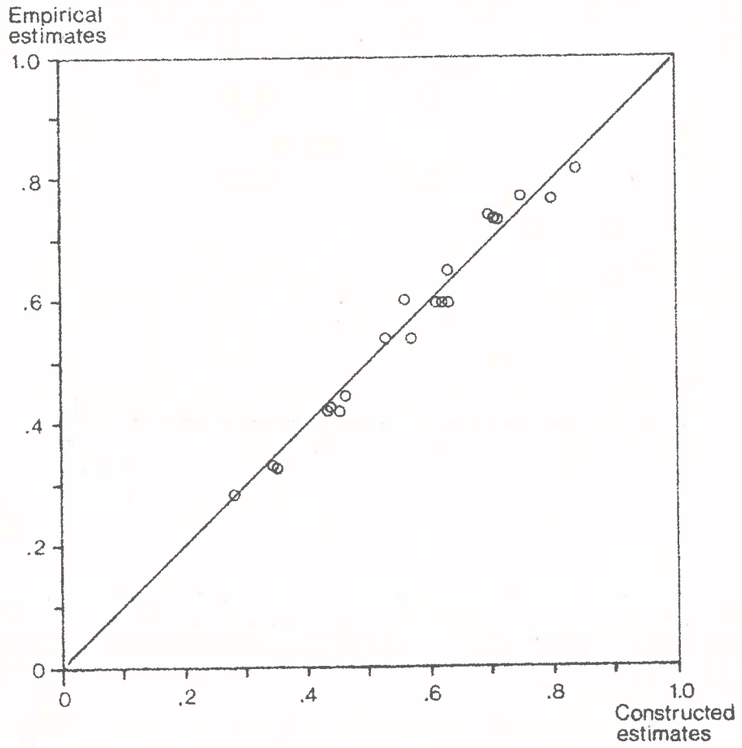


Figure 8. The inconsistency pattern in the fractional estimates for the six smallest stimuli (from 3 to 13) in the number experiment.

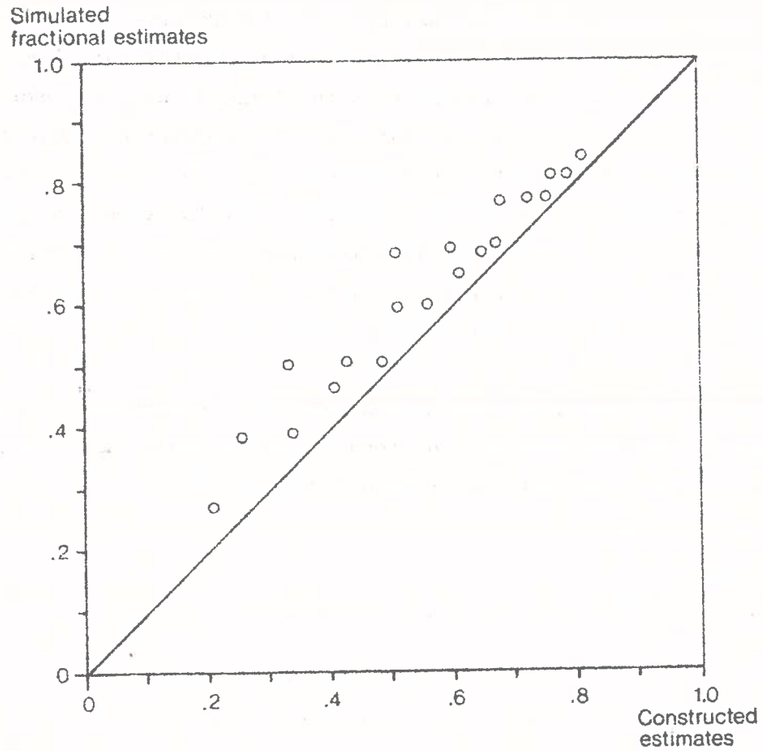


Figure 9. "The linear discriminator" at work in a hypothetical experiment with six stimuli (see text).

The ordinal estimator

The next model would give rise to a similar outcome as the one above. It presumes that the subjects only can provide estimates on an ordinal scale level, both row-wise and columnwise. With the only restriction that estimates to the left of and below a certain cell should be higher than the one belonging to the cell in question (for fractions), this type of estimator tends to give underestimations. The outcome here is dependent on the order in which the cells are filled.

An example is given in Figure 10. Here the data are based on the arithmetic means of four randomly given estimates to each cell with the restrictions of ordinality. The order in which the cells were filled were the same in the four replications but randomly determined. With an un-

limited number of replications, using only integers between 1 and 100, this estimator would end up in the linear discriminator paradigm. Consequently, it has the same drawbacks as the former model as a explanatory device. However, it may give patterns of inconsistency that resemble those from some outcomes actually obtained, e.g. for the one from Eisler (1960). To a crude eye, they may also fit a power function. The psychological rationale for this model is simple and obvious. If a subject does not have the ability to give estimates on a ratio or interval scale level he might resort to these kinds of estimates.

So far, causes of the under-estimation have only been outlined. They would appear when subjects rely on less demanding scale types than the ratio scale. The knees obtained remain inexplicable.

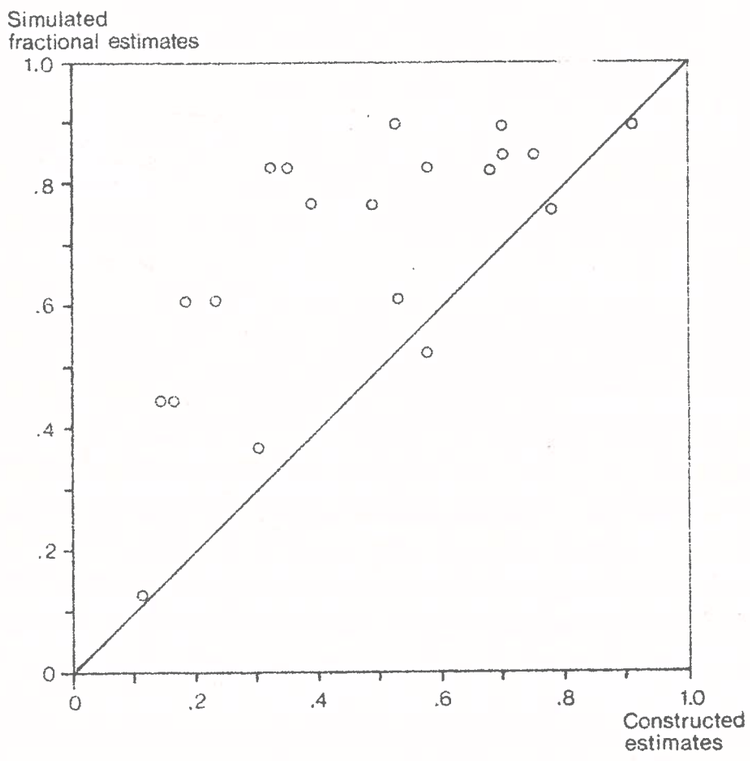


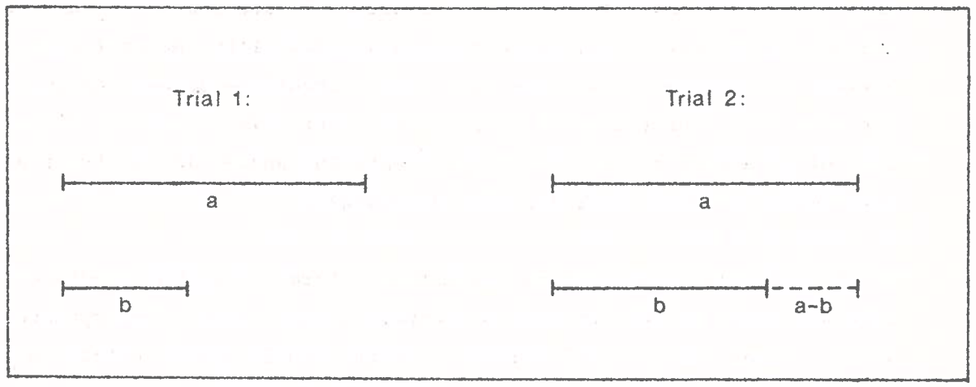
Figure 10. "The ordinal estimator" at work in a hypothetical experiment with six stimuli (see text).

The sophisticated, uncertain counter

The next model relies on some introspectively given information regarding the estimation process, obtained informally from some subjects, participating in the last two experiments earlier referred to. Its main ingredients are a counting process combined with a momentary uncertainty, felt by the subject, concerning what estimate to respond with.

The model can better be conceived with the following example in Table 2, showing standard stimulus and variable stimulus from two different trials in a line-length experiment.

Table 2. Some stimuli in two hypothetical trials.



It is assumed that the basic heuristic of the subjects in a ratio estimation experiment is to count how many times the smaller stimulus goes into the bigger one. The subjects consequently count in integers. In the first trial above the hypothetical subject might handle the situation as follows.

He counts that b goes into a more than two times and less than three times. The right estimate is somewhere in between, but he is somewhat uncertain as to the "best" estimate. Assume his interpolation between the two and three times ends "just in the middle between the two and three times". If he were to give a multiple estimate his answer would be "2,5". If he were expected to provide fractional estimates an inverting process is needed. Now the assumption is made that this inversion occurs after

the first counting process, i.e., between two and three times are inverted to "between 33 and 50 per cent". If the same interpolation would apply, the subject would take the arithmetical mean of 33 and 50, i.e. about 42 (a bias upwards).

In the second trial our hypothetical subject clearly sees that b goes into a one time but not two. The right multiple answer lies between 1 and 2 and the correct fractional answer between 50 and 100 per cent.

But this precision in the estimates resulting from the counting process is deemed unsatisfactory. The subject applies another heuristic. He uses the differences in size between a and b, i.e., (a-b). He counts how many times (a-b) goes into a in the fractional case and into b in the multiple case. Let us say it results in a credibility interval from 3 to 5 times in the fractional case i.e. (a-b), should be between 20 and 33 per cent of a. Interpolation gives 27 per cent. Since (a-b) is 27 per cent of a, b must be 100-27 = 73 per cent. The answer in the fractional case would be 73 per cent (a bias downwards).

In the multiple case (a-b) is estimated in terms of b. The credible interval might in this example be between 2 and 4 times, interpolated value 3 times. Since (a-b) relates to b as 1 to 3, a must relate to b as 4 to 3, i.e., 133 per cent (a consistent estimate).

A variant of the last approach is that the subject inverts the credible interval of 2 to 4, into 25 to 50 per cent. Interpolates it to, let us say, 38 per cent and then adds 100 per cent (for the b-portion) and answers 138 per cent (a bias upwards).

Consequently, this model can explain the knees found in the inconsistency pattern and in the S-R plot around 0.7. The change of heuristic from the one exemplified in trial one to the one in trial two should occur around 0.7, or more precisely at 0.67. That is the lower limit where the subject advantageously can use the differences, (a-b), in a counting process as compared to the ordinary variable stimulus. For example when b is about 55 per cent of a, there is no need to invoke (a-b) in a counting process. The change of heuristic is then expected to accour around 0.7.

According to this model, for values below 0.7 the multiple estimates are consistent, while the fractional ones are biased upwards. This is in line with the fact that inverted multiple estimates are lower than the fractional estimates. Above 0.7 the fractional estimates are biased downwards and those biases result in a knee. For the multiple estimates from 0.7 and upwards two possibilities were outlined. In one case there was no inconsistency or bias, in the other one there was a bias upwards (downwards for the inverted multiples). This downwards bias fits our line length data where both the fractional and the inverted multiple estimates showed the same type of knee.

A partial support for this model with consistent multiple estimates is that our multiple estimates as well as many other reported (see e.g. Hosman, 1972 op cit) are more consistent than the fractions. The same is true for free magnitude data which essentially are multiple estimates.

The bias in this model arises when the subject inverts the bounds of the credible interval and thereafter takes the arithmetic mean of these inverted values (the geometric mean would be correct). The bias grows with the widths of the intervals and with the interpolation result (the more to the middle within the interval the larger the bias). The more uncertain the subject is the larger the bias.

This model has some clear advantages. It is based on some simple and reasonable processes, the counting procedures and a momentary uncertainty. The subjects are assumed to have the fundamental capacity for valid estimates, although they must resort to some heuristics. Furthermore, it predicts inconsistencies in a principally correct way. When applied to the existent data it under-estimates the magnitude of the inconsistency and the S-curve tendency of the S-R function. An example is given in Figure 11 based on the line length data.

The outcome of the counting process was estimated on the basis of the credible estimates delivered. For example if the credible estimate were .30 to .47, it was assumed that the outcome of the counting process was "between 2 and 4" (inverted: between .25 to .50), which then were narrowed somewhat by the subject to .30 and .47 respectively. The arith-

metic mean of this primary interval was then used. It is seen that the predictions are in the right direction but that they are too conservative, there is still an under-estimation phenomenon. Obviously the model cannot in itself account for the large inconsistency found e.g., in Eisler's data (1960 op cit.), but possibly in connection with other models.

The simple-minded uncertain counter

The last model is based on the same factors as in the model above, i.e., on a momentary uncertainty and/or a counting process. By means of the counting process the subject "frames" the correct estimate. In this version the subject invariably gives an estimate which is the arithmetic means of the interval bounds (or some other interpolated value) set by the counting process. For example if the subject finds that the variable stimulus is between 1 and 2 times the standard (or between 50 and 100 per cent in the fractional case) the answer is always 1.5 (0.75 for fractions). It resembles a contrast effect. This would lead to values between 0.5 and 0.75 being overestimated and values between 0.75 and 1.00 being underestimated. Similar over-estimations and under-estimations occur at other levels, but their magnitudes are less than between 0.5 and 1.0. For values close to the integers (and their inversions) an "assimilation" process is assumed.

The result of such an heuristic would be a step function with a knee around 0.7. Likewise the underestimations at higher levels would arise, as well as those found just below 0.50 (in line length experiment at least). The resulting bias in a hypothetical S-R plot is shown in Figure 12. The smoother deviations are those that would arise, if the subject tried to preserve an ordinal structure in the estimates by avoiding the invariable use of the same interpolated value.

This model might account for the larger deviations found. As in the former counter model, the level of the obtained estimates play an important role. It predicts that another pattern of inconsistency would occur if e.g., stimuli resulting in estimates between 0.5 and 0.75 are avoided. This has not been tested yet. Likewise it explains why inverted multiple estimates are lower than fractions. The S-curved S-R plot of Eisler (1960 op cit.)is however at variance with this model although it is in the right direction.

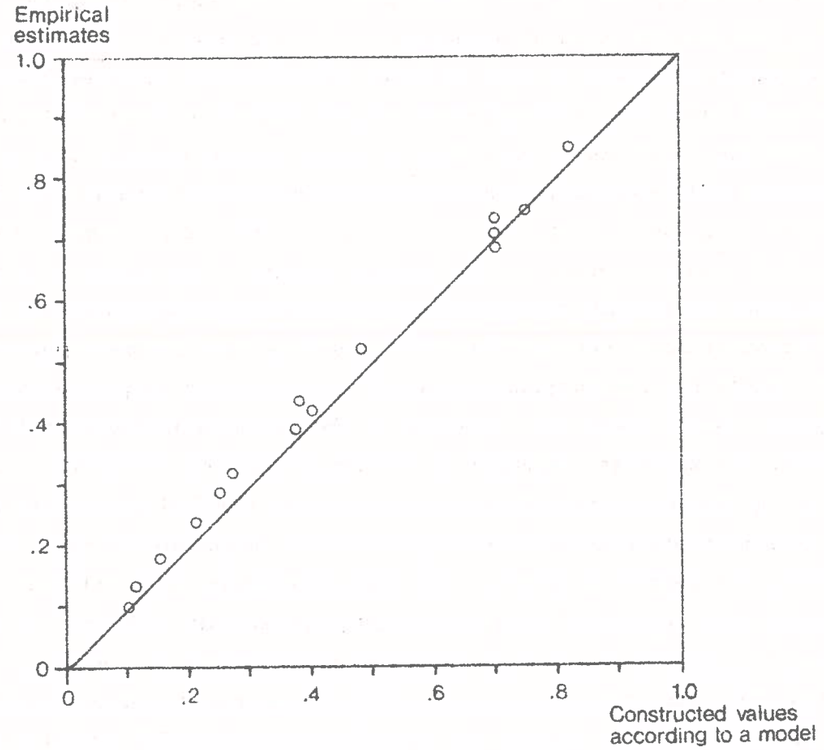


Figure 11. The fractional estimates from figure 2 a corrected by the rationale of "the sophisticated, uncertain counter". This model cannot wholly reduce the inconsistency pattern.

General discussion

Four models for the inconsistency of ratio estimates have been presented. Two of them, the linear discriminator and the ordinal estimator, explain the inconsistency in terms of an inability of the subjects to perform the required mental operations, i.e., to estimate the stimuli on a ratio scale level. The other two models, the sophisticated uncertain counter and the simple-minded, uncertain counter respectively ascribe the subjects a capacity to perform these operations but not to handle the momentary uncertainty adequately. The former two models are better off in accounting for the large deviations from consistency, the latter two for the minor ones.

None of them seems sufficient enough to explain all inconsistencies found. This is partly due to the fact that the inconsistency found for various continua has not been of a complete uniform character. The inconsistency for weight and velocity, to take two examples, has been much more pronounced than for line length and numbers. Likewise fractional estimates often generate more inconsistent patterns than (inverted) multiples do, and the under-estimation phenomenon is not generally valid over the whole range used. That the inconsistencies for various continua should differ from each other is not incomprehensible. The number continuum and the line length continuum are both prototypes par excellence of the concept of magnitude and that they should be less inconsistent and easier to handle for the subject than weight and velocity is perfectly intelligible. The difference is revealed on the one hand in the magnitude of the subject's momentary uncertainty (widths of credible intervals) and in the introspective reports on the other. The difficulty in this latter respect is often expressed by the subjects in the following way:
"I really sense two definite and different magnitudes, but what is their true relation? Does this relation constitute 50%, 30%, or what?"
For the subject the task is basically a conceptual or "semantic" problem. This can easily be recognized when compared to the ease with which the subject judges whether the relation is one of 100% or not. The strategy to solve this semantic task determines the type of scale obtained. It should be obvious that the semantical problem for line length would be easier than that for weight where the accessibility to mental operations of a ratio scale should be less.

The quantitative difference in patterns of inconsistency between various continua does not pose a problem. There is, however, one difficulty that requires further explanation. It is the qualitatively different patterns obtained for inverted multiple estimates for line length and number. The knee was present here in opposite directions. It was bent downwards for line length and upwards for number. A reasonable explanation for the last effect is that values slightly above 1.0 (below for the inverted values) arise due to a more or less random adding of constants, e.g., .1, 0.2. Thereby the effect of an upbent knee, and the higher levels of estimates as compared to the fractional ones as shown in Figure 7.

But why is not the same strategy used for line length? Numbers differ from other continua in at least one respect. It presents its stimuli in a perfectly precise way and as a consequence the only uncertainty connected with a response is the relation between the stimuli, not to the separate stimuli that may be the case for other continua. There may also be a difference in inducing deliberate calculations in contrast to estimation. The effective mechanism behind this difference in outcome remains, however, unrevealed.

The knees around 0.7 in the inconsistency pattern and in the credible intervals have both been given a provisional explanation in terms of the uncertain counter models. As for the inconsistency pattern, a further possibility should be mentioned. It was seen that inability of the subjects to conform to the ratio scale demands might result in inconsistency patterns similar to those often found. On simple probabilistic grounds it may e.g., in connection with the ordinal estimator, be predicted that the deviations from consistency would be largest at levels coinciding with the opposite diagonal (i.e. from upper left to lower right corner). Then, if the deviations are considerable, this might be interpreted as knees occurring around 0.7 in terms of the ordinate. Such an ordinal estimator would also be in accordance with the S-curve tendency in the psychophysical functions. All in all, with the explanations presented here our knees should not be as puzzling as before.

Finally a few words are needed concerning the results with symbolic set concepts used as stimuli. The subjects behaved here as in traditional scaling experiments and essentially the same pattern of inconsistency arose as for other continua. This elucidates the uniqueness of man as an instrument. The task given to the subject here is of the kind that never could be performed by an ordinary instrument, i.e., a device that reacts in accordance with some "natural law". Physical measurement of this task would be impossible, due to the inherent vagueness and indeterminateness of the stimuli. To be able to perform this task some further manipulation of the stimuli is needed. In addition this manipulation is by necessity arbitrary since there are no common strict rules to follow. Still the subjects did all that without hesitation.

It is obvious that the subjects here not only reacted to, or mirrored, the stimuli but also created their magnitudes. The set concepts did not induce definite "sensation magnitudes" on to which adequate labels were put. There were no true "sensation magnitudes" even in principle but a range of possible magnitudes. What the subjects actually did was to select a point estimate from a set of reasonable estimates.

The momentary uncertainty felt by the subjects in connection with these point estimates was undoubtly due to the conceptual vagueness of the task rather than to any sensory deficiency. Consequently, this uncertainty could not be reduced by a "perfect instrument". Conceptual vagueness may only be handled by analysis and, in want of any definite solution, by conventions.

By necessity, the point estimates in this experiment had an arbitrary, conventional and prototypical character. The estimates represent rather than present or indicate a hypothetical perceptual phenomenon. As such, the estimates may not be interpreted literally.

The problem here is to interpret what they represent, to know from what "population" the estimates are selected or sampled. Unless the point estimates are supplied by credible intervals or similar indices, the represented population is seldom known. Often the point estimates are accompanied by words as "approximately", "around", etc which emphasize the inprecision and the basic arbitrariness in the estimates. Ignorance of what the point estimates represent makes it impossible to evaluate the instrumental character of the estimates.

Thus the similarity here to an ordinary instrument is quite superficial. The "measurement result" or estimate represent rather than present a phenomenon. It is generated solely by conceptual analysis rather than by a sensory process. The similarity is obtained by an artificial restriction and treatment of the responses given by the subjects.

The question is if the same type of estimation process is working in ordinary ratio scaling settings. The inconsistency pattern and the want of any specific reactions from the subjects in our experiment support such a hypothesis. If so, the lesson to be learned is that there is no necessary one-to-one correspondence between a point estimate and a

"sensation" induced by the stimuli. An estimate does not prove the existence of a corresponding experiential event.

As a consequence, man as an instrument is a very misleading analogue. From the subject's point of view the scaling situation is to a large degree a conceptual or semantic enterprise, not a blind automatic reaction to a stimulus configuration to be read off by the experimenter. Even in the simplest of situations man shows himself to be an intentional being both in his semantic efforts and in his aim with the estimate.

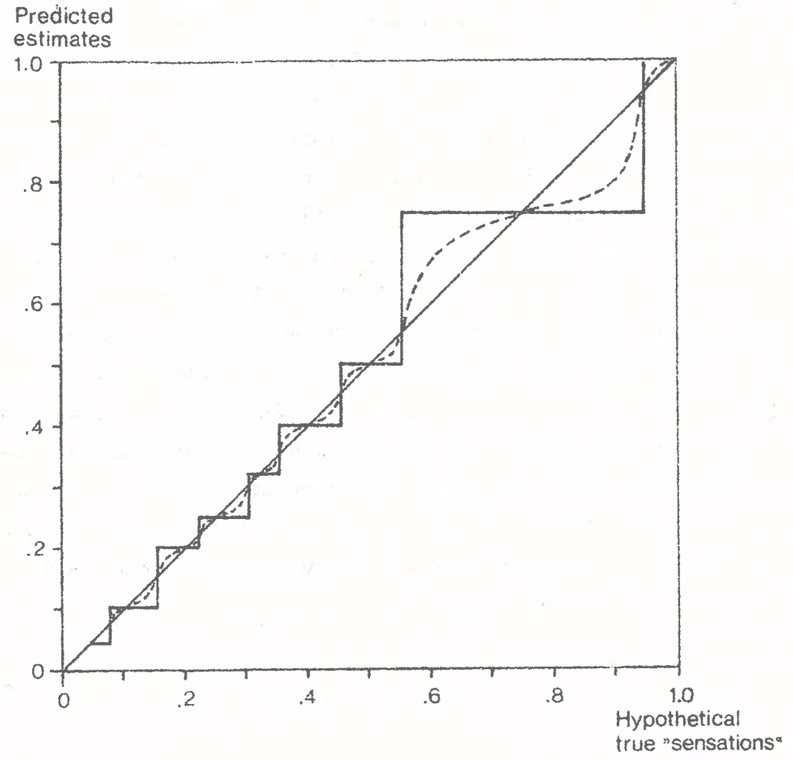


Figure 12. "The simple- minded uncertain counter" at work in a hypothetical S-R plot.

This intentional and interpretational aspect of the situation has been neglected in the search for alleged laws or invariant relations between stimuli and responses, mirroring "sensations" or transducer functions etc. Such an approach might be defended if it would increase our understanding of the functioning of man or if it would prove useful from another point of view.

As for the latter case, the fact is that hitherto direct ratio scaling outcomes have been rather useless. Steven's law has not been of much practical help to man and that is probably due to the representative, prototypical component in the responses which are not possible to justify since they in a large degree are arbitrary and conventional. For the former case, to understand the implications of the invariants found, a further interpretational stage is necessary. The context in which the estimates have been delivered must be considered. To take one example, what does it mean that a weight X is estimated to be double as heavy as weight Y? That the subject estimates that he can lift X for half as long a time as Y? Or what? Since the dimensional interpretation of a numerical relation system is a convention, the grounds for that convention must be known to understand the functioning of man. In this paper, a modest attempt has been carried out towards that direction. By and large, however, the direct ratio scaling techniques has an essential resemblance to the ones used when measuring "intelligence" and "entropy" and similar concepts. You measure something but you do not know what. The difference is that for the latter concepts the usefulness is beyond question.

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REPORTS FROM THE INSTITUTE OF APPLIED PSYCHOLOGY
THE UNIVERSITY OF STOCKHOLM

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PERCEPTION OF CHEST PAIN DURING PHYSICAL WORK IN A GROUP OF PATIENTS WITH ANGINA PECTORIS

No. 81, 1980

CONTENTS

PERCEPTION OF CHEST PAIN DURING PHYSICAL WORK IN PATIENTS WITH ANGINA PECTORIS*

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Sixty-three male patients with angina pectoris were investigated before coronary bypass surgery. They were tested on a bicycle ergometer. At the termination of the test they all had ECG changes indicating coronary insufficiency. They were asked to rate their chest pain during the ergometer work according to a nine-point category scale with verbal expressions. Heart rate and blood pressure were recorded together with the ratings at the end of every work load, which was increased by 10 W each minute. The patients were divided into three groups, depending upon the final work load. All groups stopped working at the same rated pain intensity regardless of the test duration and severity of coronary heart disease. The increase in pain intensity accelerated slightly with increasing work load and heart rate.

Introduction

The recording of pain perceived by patients with angina pectoris supplies information which may be very useful for diagnosis, selection of therapy and evaluation of treatment. It is also of interest in studies of pain changes over time. The need for reliable methods of rating symptoms has increased considerably during the past few years. A need exists for methods that facilitate the "description" or communication of perceived pain intensity between the patient and the medical staff.

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The main concern in this study has been recording of pain intensities. The perception of pain, however, is a complex problem since it includes not only simple sensations, but also emotional and cognitive factors. The quality of pain may vary considerably between individuals, because of both sensory differences and personality differences. However, in a well-controlled laboratory situation in which a homogeneous group of patients are tested with a simple stress test, a great deal of information may be obtained by intensity recordings.

When perceived intensities of symptoms during physical exertion are studied in different groups of patients a rating scale with verbal expressions is often used. Borg and Linderholm (1967) found that patients with vasoregulatory asthenia had higher heart rates at equivalent ratings of perceived exertion than a normal group of individuals. Patients with coronary heart disease and chest pain, had significantly lower heart rates at equal ratings. The rating scale used was the so-called RPE-scale (Ratings of Perceived Exertion, Borg, 1962, 1970) which proved to be of differential diagnostic value.

The aim of this study was to investigate how chest pain increases with physical exertion in a group of patients with angina pectoris. The main objective was to study the variation in *intensity* of pain during a bicycle ergometer test, since the increase of pain in this kind of test has proved to be of great clinical interest.

P a t i e n t s a n d M e t h o d s

Sixty-three male patients with diagnosed coronary heart disease and severe angina pectoris participated in the study. Most of these patients had consulted the hospital's emergency department. All patients had been accepted for surgical treatment. Their main symptom consisted of severe chest pain of angina pextoris type. All patients developed ST changes indicating coronary insufficiency in a 12-lead ECG during exercise. They had not responded to ordinary medical treatment. Table 1 shows means and standard deviations for age, height, weight in the whole group of male patients.

Table 1. Means (M) and standard deviations (SD) for age (years), height (cm) and weight (kg) in the whole group of patients. n = 63

	Age	Height	Weight
M	54.4	175.4	83.1
SD	6.5	7.6	11.9

The patients performed an exercise test on a bicycle ergometer. The work load was increased by 10 W every minute, beginning with 10 W. An ECG was recorded during the test and blood pressure and ratings of perceived chest pain were recorded at the end of each work load. Perceived pain was rated on a nine-point scale, which is a modified version of the RPE-scale. The scale was presented to the patients in a 21 x 31 cm format: 1 *None at all*, 2 *Extremely light*, 3 *Very light*, 4 *Rather light*, 5 *Not so light, rather strong*, 6 *Strong*, 7 *Very strong*, 8 *Extremely strong*, 9 *Maximum, unbearable*.

The patients were instructed to recollect the severest anginal pain that they had ever experienced and to use that as a frame of reference. This pain level was to be equivalent to a rating of 8-9 ("Extremely strong/Maximum, unbearable") on the nine-point scale. As a second reference, besides freedom from pain, the pain level which forced the patient to stop walking in his daily life was used. This level was to be equivalent to a rating of 5-6 ("Not so light, rather strong/ Strong").

R e s u l t s a n d D i s c u s s i o n

The patients were divided into three groups depending upon their final work load, which was assumed to be closely related to maximal working capacity. This classification of the patients into groups I, II and III was also related to the severity of ischaemic heart disease, III being the least severe.

Table 2 shows the mean values and standard deviations for each group.

Table 2. Means (M) and standard deviations (SD) of each group for age (years), height (cm), weight (kg), heart rate at rest (HR_r), rating at rest (R_r), final work load (W_f), highest observed heart rate (HR_f) and final rating (R_f).

		Age	Height	Weight	HR_r	R_r	W	HR_f	R_f
GROUP I (n=27)	M	55.1	174.6	81.7	68.1	1.3	58.2	104.8	6.0
	SD	5.8	8.7	12.0	10.1	0.6	12.1	20.5	1.4
GROUP II (n=27)	M	54.4	175.8	83.1	68.1	1.0	102.2	114.6	5.6
	SD	6.9	6.9	12.3	9.5	0.0	12.8	14.6	1.0
GROUP III (n=8)	M	52.2	178.0	87.2	67.4	1.1	146.7	134.7	5.7
	SD	8.4	5.9	10.7	10.8	0.3	14.1	13.7	1.2

No statistically significant differences between the groups were found for the variables age, height, weight, pain rating at rest and final pain rating. The differences in final work load and in highest observed heart rate between group III and the other two groups are highly significant ($p \leq 0.001$ and 0.01 respectively).

It is interesting to note that all three groups stopped working at the same pain intensity. This similarity is probably reinforced by the instructions given to the patients.

Table 3 shows the means and standard deviations for the variables heart rate and pain rating for each group at all working loads.

Table 5. Means (M) and standard deviations (SD) for heart rate (HR) and pain rating (R_p) at all work loads for all three groups.

			WATT	10	20	30	40	50	60	70
GROUP I n=27	HR	M		84.4	87.9	91.2	96.7	101.1	107.8	
		SD		13.6	14.1	14.9	16.4	18.5	19.7	
	R_p	M		1.5	1.9	2.1	3.0	4.3	4.8	
		SD		0.9	1.3	1.3	1.6	1.7	1.4	
GROUP II n=27	HR	M		80.3	83.2	85.8	89.1	92.7	95.1	100.0
		SD		10.2	9.7	11.3	11.1	11.3	11.7	12.6
	R_p	M		1.0	1.1	1.3	1.5	1.8	2.0	2.9
		SD		0.2	0.3	0.6	0.9	1.2	1.4	1.7
GROUP III n=9	HR	M		79.1	82.7	84.0	88.1	91.0	94.1	98.0
		SD		12.0	10.5	10.1	10.0	9.6	10.1	10.3
	R_p	M		1.1	1.1	1.1	1.1	1.1	1.3	1.4
		SD		0.3	0.3	0.3	0.3	0.3	0.5	0.5

			WATT	80	90	100	110	120	130	140
GROUP II n=27	HR	M		104.0	109.4					
		SD		13.3	12.6					
	R_p	M		3.4	4.2					
		SD		1.8	1.5					
GROUP III n= 9	HR	M		101.2	106.9	111.1	116.4	121.1	126.1	134.7
		SD		10.4	8.9	10.6	10.7	11.9	12.6	13.7
	R_p	M		1.6	1.7	2.2	3.0	3.8	4.7	4.9
		SD		0.7	0.9	1.4	1.4	1.8	1.7	0.9

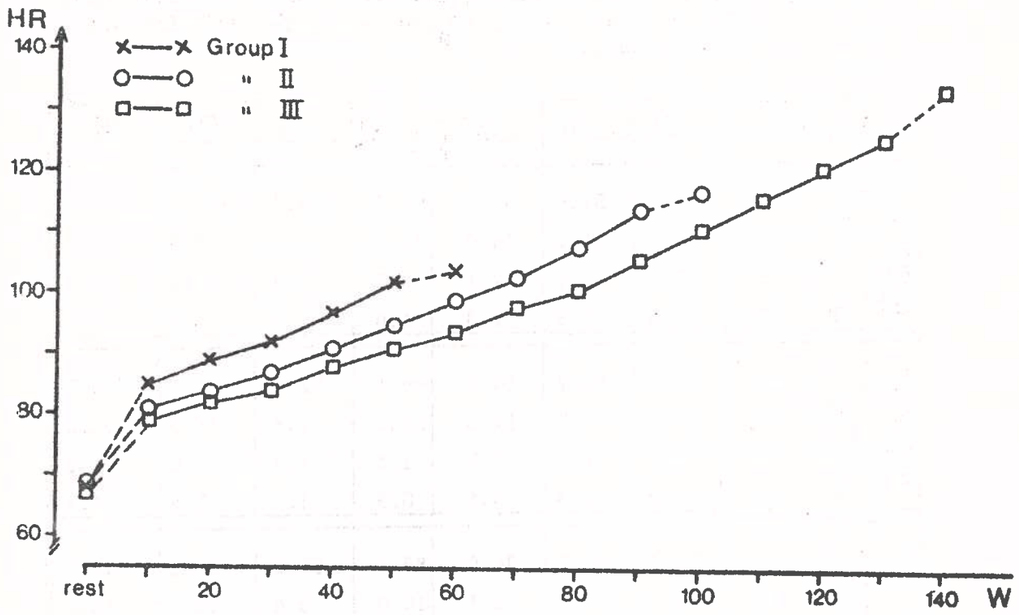

Figure 1. Mean heart rate as a function of work load for the three groups.

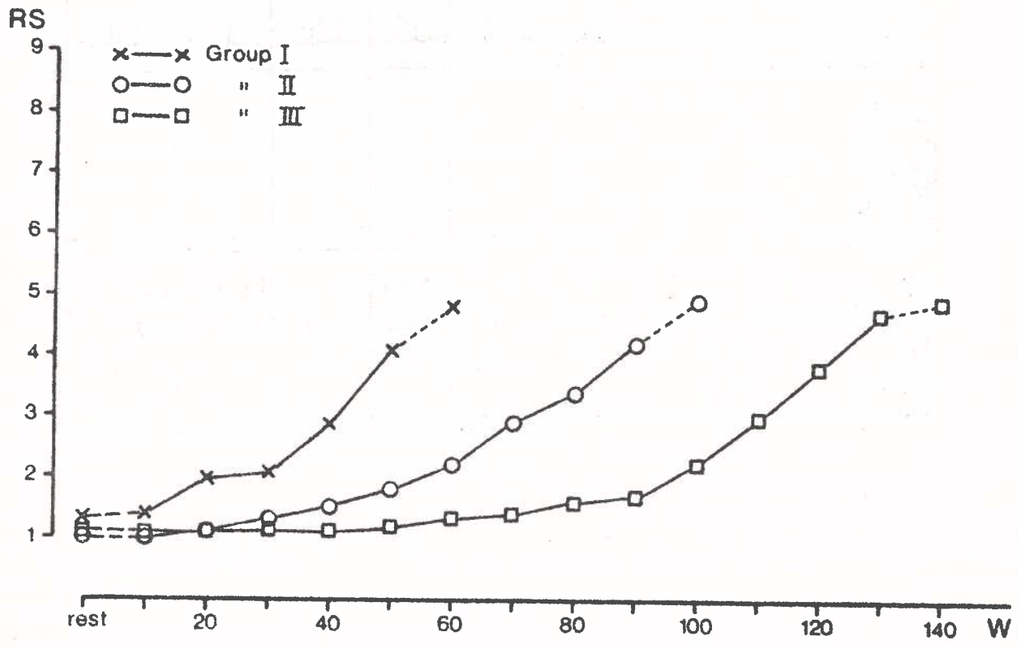

Figure 2. Mean pain ratings as a function of work load for the three groups.

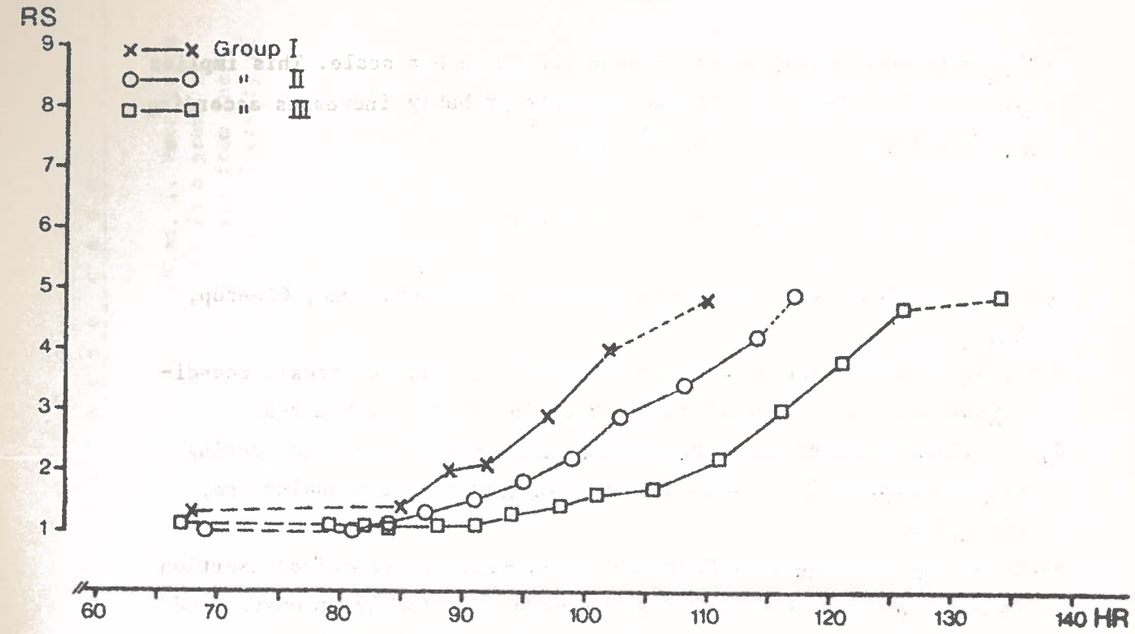

Figure 3. Mean pain ratings as a function of heart rate for the three groups.

From Table 3 and Figures 1, 2 and 3 it will be seen that the increase of pain (i.e. the slope) was much the same in all three groups after rating 2. In group I pain began to occur at a very light work load. In the other two groups (II and III) the test was of longer duration and the patients worked longer before experiencing pain. This was especially true for group III. When pain was definitely perceived the increase followed the same trend as in group I.

At this stage it is not possible to describe more precisely the actual development of pain since a ratio scaling method was not used. Such a method has proved to be too complicated to use in this type of test situation, because it requires that the patient thinks in ratios and handles numbers in a precise way during the exercise test. Furthermore, an ordinary ratio scaling method would not enable direct inter-individual comparisons. In the clinical situation a category scale therefore seems preferable.

It has previously been shown that the type of category scale used here is not linearly related to the ratio scale, but grows according to a

negatively accelerated function when set to such a scale. This implies that the pain intensity in these patients probably increases according to a positively accelerating function.

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Abstract card

Borg, G., Holmgren, A. and Lindblad, I. Perception of chest pain during physical work in a group of patients with angina pectoris. Reports from the Institute of Applied Psychology, the University of Stockholm, No. 80, 1980. Sixty-three male patients with angina pectoris were investigated before coronary bypass surgery. They were tested on a bicycle ergometer. At the termination of the test they all had ECG changes indicating coronary insufficiency. They were asked to rate their chest pain during the ergometer work according to a nine-point category scale with verbal expressions. Heart rate and blood pressure were recorded together with ratings at the end of every work load, which was increased by 10 W each minute. The patients were divided into three groups, depending upon the final work load. All groups stopped working at the same rated intensity regardless of the test duration and severity of coronary heart disease. The increase in pain intensity accelerated slightly with increasing work load and heart rate.

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REPORTS FROM THE INSTITUTE OF APPLIED PSYCHOLOGY
THE UNIVERSITY OF STOCKHOLM

LENNART HALLSTEN

CREDIBLE INTERVALS AND THE VARIABILITY OF ESTIMATES: TWO INDICES OF UNCERTAINTY

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CREDIBLE INTERVALS AND THE VARIABILITY OF ESTIMATES: TWO INDICES OF UNCERTAINTY*

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In scaling experiments uncertainty is usually handled by means of variability in the responses. Any uncertainty felt by subjects concerning the adequate response to a stimulus may not, however, appear in the variability of the responses. A more appropriate index of this momentary uncertainty is, perhaps, the widths of the "credible intervals", i.e. the intervals formed by two simultaneous estimates, a lower bound and a upper bound estimate, that to some degree of credibility cover the most appropriate response. A variability index and an index based upon credible intervals were compared in data from three direct ratio scaling experiments. In most cases these two indices conveyed some redundant information but they were evidently due to different cognitive processes. Interpretations of these outcomes are discussed as well as the problems of incorporating the results into a reasonable epistemological framework for scaling experiments. It is emphasized that a basic inconvenience in traditional direct scaling procedures is that a response "A" given to a stimulus does not allow the inference that "not-A" is inadequate. This may, however, be avoided by using credible intervals.

Introduction

Our ignorance of the true state of the world and the impossibility of complete knowledge are theses from epistemology that are widely recognized in theories and models of perception. The doctrine of naive realism has not had many advocates (J.J. Gibson may be an exception). This becomes obvious even in descriptions of situations where common-sense considerations otherwise would show that absolute certainty prevailed concerning the world. Ordinary everyday perceptions of tables, chairs and persons are often technically described as "expectations" or "hypotheses" (see e.g. Gregory, 1974, p.255). The terms used imply an indirect connection between the percept (or sensation, sensory magnitude, etc) and the outer world. It is generally

* This study was supported by a research grant from the Swedish Council for Social Science Research to professor Gunnar Borg (No. 169/757).

assumed that some inferential and judgmental processes are involved in perception, whether these processes are conscious or not. Since every judgment process is fallible, perception would always be accompanied by uncertainty.

Scaling and psychophysics are some areas of psychology where the perceptual processes are generally held as being at issue. It may then seem surprising that there has seldom been any explicit address to a prevailing uncertainty concerning the adequate response in the instructions to the subjects. The instructions give the impression that it is assumed that the subject has a complete knowledge of the adequate response and thus has no experience of uncertainty.

A typical scaling experiment requires the subject to report about his sensation which corresponds to a stimulus. The aim is to erect a scale value for the sensation and, sometimes, to arrive at a psychophysical function relating physical and sensational scale values. The instruction to the subject in a magnitude estimation procedure may be formulated as: "You will be presented with a series of stimuli in irregular order. Your task is to tell how - they seem by assigning numbers to them. Call the first stimulus any number that seems to you appropriate. Then assign successive numbers in such a way that they reflect your subjective impression. For example, if a stimulus seems 20 times as -, assign a number 20 times as large as the first ..." (Stevens, 1971). It is questionable whether this type of instruction presupposes some form of uncertainty concerning the adequate number to the subjective impression. In any case, by this instruction the subject is not allowed to show any uncertainty in his report.

There may be at least two justifications for this procedure. The first is related to the thesis of solipsism, which states that the only things one may know for certain are one´s own sensations, while one never can be sure about things or events outside one´s mind. Since the task of the scaling experiment often is said to be to report about sensations and not the outer world, this might then be performed by the subject without involving any uncertainty. The subject should be quite certain about the adequacy of his report and he should not experience any lack of confidence.

The second justification relates to the conception of the subject as an instrument, "measuring" the subjective intensity of the stimulus. Ordinary measuring devices for physical magnitudes are not considered to indicate any momentary uncertainty and consequently there is no need to postulate any momentary uncertainty for the subject as long as he acts as an instrument in the generation of a response. The only form of uncertainty involved in these cases is, in fact, the uncertainty experienced by the experimenter. This uncertainty is based on the non-constancy of the results from repeated measurements of the same stimulus, i.e. the variability.

The conclusion is, then, that any uncertainty experienced by the subject in a scaling experiment is irrelevant, if at all present. The only interesting kind of uncertainty here is the experimenter´s own uncertainty, which may be manifested when predicting the next response to be given by the subject. The assumption held regarding the subject is that there is a momentary one-to-one correspondance (to a predetermined degree of precision) between the stimulus and the sensation but that the sensation acts as a random variable, thus giving rise to variability in the responses. The ultimate aim is to obtain a scale value and if this can be reliably done by direct estimates from the subjects, then the processes responsible for the responses given are of minor importance.

This instrument-view of the subject has, indeed, some merits in that it is parsimonous and free from antropomorhic flavor. Nevertheless, this attitude can be seriously questioned. First, the instrument-view is difficult, if not impossible, to refute with its traditional and pressupposed design of pairing a single response to the stimulus in each trial. This design, thus, has a self-fulfilling character since it is not possible to obtain anything but an one-to-one correspondance between the stimulus and the response (the sensation). Second, the instrument-view may be misleading, if not false, in offering a simplified explanation to the outcome of scaling experiments. Although there certainly are some formal similarities between an ordinary instrument and a subject in a scaling experiment, the processes behind the outcomes seem highly different. This is indicated by the fact that it is reasonable to use terms such as "alternatives" among a set of potential responses or "mistakes" when a subject is involved, while such terms are conceived as being quite misplaced when attributed

to an instrument. Whatever the value of such "meta-language" suggestions, it points out the danger of stressing too close an analogy between a subject and an ordinary instrument.

A further reason to question the instrument-view is that subjects do not exhibit internal consistency in their reports (c.f. e.g. Eisler 1960, Hosman, 1972), which is a minimum demand for an acceptable instrument. The inconsistency has to a very crude level shown some degree of lawfulness (derived scale values are usually lower than the empirical ones) but as to the details there has been a considerable variation over subjects and conditions as well as a large intra-individual "random scatter". Erecting consistent scales under these circumstances by means of mathematical transformations of the empirical values is to trivialize the problem, since such an approach always is available to any kind of data.

In light of these weaknesses connected to the instrument-view it seems less prolific to continue the deliberate ignorance of the processes responsible for the estimates with the traditional experimental design in a search for critical, biasing factors outside the subject. It would be desirable to narrow the usual S-R arc.

An alternative is offered if a closer look is taken at the cognitive processes which mediate the independent and dependent variables usually concentrated upon in scaling experiments. Few would deny that conscious decisions are made by the subjects in direct scaling procedures, but there has not been any explicit attention to them. Through such an outlook, however, a change is made from the interest in obtaining scales for subjective dimensions to a more exclusive interest in the mechanism of the instrument itself, similar to the attitude held when intrasubjective relations are studied (see e.g. Eisler, 1963a).

In some earlier studies with this latter outlook (Hallsten, 1971 a, b, c; Hallsten 1975 a, b) a direct ratio estimation technique was used with the basic assumption that subjects in each trial experience a momentary uncertainty about which response to give to the stimulus in question. The subject might accept several response values as adequate, but in some way or the other he must decide which single response value to select. The usual instruction affords no help here and the subject must choose his own criterion for

determining the most representative response to his sensation.

As an expedient the method of "credible intervals" or "interval estimates" was used to study the assumed momentary uncertainty. The essential point in this technique is that the subjects respond with an interval, i.e. two responses in each trial, an upper bound estimate, Ψ_u, and a lower bound estimate Ψ_l. These intervals should correspond to certain credibility levels. In addition, these interval estimates may be supplied with a "point estimate" Ψ_m, corresponding to "the most probable estimate" for the stimulus at hand. If the interval estimates Ψ_l and Ψ_u did not coincide, this was regarded as an indication of a momentary uncertainty. (For further information about the method of credible intervals the reader is referred to Raiffa, 1968; Stael von Holstein, 1971; Peterson, Snapper and Murphy, 1972).

This view of credible intervals in connection with a scaling experiment explicitly recognizes the possibility of only partial knowledge of one´s own sensations and stresses the momentary uncertainty felt by the subjects. The thesis of solipsism is not adhered to. The sensation is not postulated to have a precise quality such as that of numbers, geometrical points and traditional psychophysical reports, a fact also doubted by Anderson (1974, p. 214).

The above-mentioned studies by Hallsten lent strong support to an existing momentary uncertainty felt by the subjects. Thus the instrument-view with its denial of a momentary uncertainty was refuted.

This being the case, it is of interest to study the relationship between the variability of direct ratio estimates and the momentary uncertainty as expressed by credible intervals and this is the aim in the present study. The basic hypothesis to be tested is if the variablility and the width of credible intervals are due to the same cognitive processes, i.e. that the variability correlates with the width of the credible intervals. Furthermore, since variability is a more often used index, the regression of credible intervals on variability is to be studied with specific interest to the question whether a momentary uncertainty can be precluded even when variability is nil. To accomplish this some adequate uncertainty indices, based on variability and width of credible intervals, are needed.

Two indices of uncertainty

If some kind of variability is presumed to convey the uncertainty experienced by the subjects, it seems sensible to start from the intra-individual standard deviation of the estimates for a certain stimulus. This is what Eisler (1962, 1963 b, 1965) has done in one of the few attempts to deal with the uncertainty of the subjects in scaling settings. Some kind of transformation is, however, called for since the standard deviation is dependent on the numerical level of the estimates. A change in the number given to the standard should not effect the uncertainty. By logarithmizing the estimates, an acceptable index is secured and this transformation is also consonant with the assumption that the variability of the estimates is distributed log-normally (see e.g. Stevens and Guirao, 1962, Hosman, 1971). $\sigma_{\log\Psi}$ or, more exactly, its sample version $s_{\log\Psi}$, is therefore chosen as the variability index to reflect the uncertainty experienced by the subjects. The variability is here based on the "point estimates", $\bar{\Psi}_m$, used in connection with credible intervals.

If credible intervals are to be used in a construction of an uncertainty index some transformation is again necessary. As for the case of the standard deviation of the point estimate, the size of the intervals can be expected to increase with the numerical level of the estimates. This drawback may be eliminated by using the inverse of the index of momentary precision, Ψ_l / Ψ_u (Hallsten, 1971 a, b), and this ratio will be used here.

Thus, we have two different indices of uncertainty in a direct ratio scaling procedure with the credible intervals technique, $s_{\log\Psi}$ and the inverse of Ψ_l / Ψ_u. If these two indices are expressions of the same kind of uncertainty, they should be expected to be negatively related to each other. This assumption has received some partial corroboration earlier (Hallsten, 1971 a), but this hypotheses will now be further scrutinized with some additional data.

With regard to the details of the relationship between these two indices, two different types of mathematical functions will be applied to the data. If the two indices convey the same information, the ratio Ψ_l / Ψ_u should equal 1.0 when $s_{\log\Psi}$ is 0.0 and, in addition, Ψ_l / Ψ_u should approach 0.0

when $s_{\log\Psi}$ approaches infinity. These demands are most simply described by the function $y = e^{-\beta x}$, where y corresponds to Ψ_l / Ψ_u and x to $s_{\log\Psi}$. However, if the y-intercept does not correspond to 1.0 but, e.g. to a value below unity as would be expected if a momentary uncertainty always exists, one additional parameter must be allowed. Thus the exponential function $y = \alpha e^{\beta x}$ is here fitted to our data.

Other mathematical models are, however, conceivable since it is virtually impossible for the variability index to approach infinity. In each practical setting there will be a definite maximum of the variability. If the precision index Ψ_l / Ψ_u approaches zero at this maximum variability, the exponential function loses its precedence. A linear function $y = \beta x + \alpha$ is also applied as an alternative description of the empirical relationship.

These two models are here regarded as sufficient since the main objective is to study whether or not there is a negative relationship. Neither was any other model suggested after crude visual inspection of the data. The degree of fit of the empirical data to the functions is here to be evaluated by product-moment correlations. For the β-parameters, only the sign is of interest, while the level is of great importance for the α-parameters. If α is below unity, it then suggests that a momentary uncertainty always may exist, even when the variability is zero.

The experiments

The empirical data used here are from three earlier studies (Hallsten, 1971 b; Hallsten 1971 c and Hallsten 1975). Let us call these studies study A, B and C respectively. (For a more complete description of these studies the reader is referred to these three reports).

Study A

In study A the subjects had to estimate the intensity and duration of sinusoidal tones by a magnitude estimation technique. In each trial the subjects were required to give three responses, two interval estimates and a point estimate, according to the following instructions:

"... Your task is now to estimate the relationship between the < intensity/duration > of these tones ... The first one, the standard, is always given the number "10", and you are to give an appropriate number to the second tone, the variable. E.g. if you perceive the second tone as twice as < intense/long > as the first, then you say "20". ... These estimates are called point estimates. You have one additional task in this experiment: you are also to give so-called interval estimates, which means that you are to state an interval within which you perceive the variable tone to be... If, for instance, you perceive the variable to be between three and seven times as < intense/long > as the standard then you answer "30-70", ... You may respond with any interval you like.

Now you are to state these interval estimates according to one special principle: *You are to respond with the smallest interval within which you are practically quite certain (approx. 100%) that your perception of the variable is situated* ... When you have heard the two tones you should first state an interval according to the principle mentioned, and then give the most probable value, i.e. a point estimate, ..."

The study was divided into six conditions. Conditions I to III were for the intensity or loudness of the tones. In condition I the subjects were to give their estimates according to their percepts of the stimuli, while they in the other conditions were to estimate the physical relation between the stimuli, i.e. they were to commit the "stimulus-error". In condition II and III they were to deliver the interval estimates Ψ_l and Ψ_u so that they could maximize a total score and a sum of money, respectively. Conditions IV to VI were applicable to the duration of the tones. In condition IV the estimates were to correspond to their percepts. In condition V and VI they had to estimate the physical relationship and try to maximize scores and money, respectively. Twenty subjects participated in each condition. Eight stimuli were used for both continua. The number of replications given to the same stimulus was ten.

Study B

In study B the subjects were asked to judge the perceived length of six lines in a complete ratio estimation procedure. Thus, there were in all 36 different combinations of stimuli and each of the 20 subjects estimated each of these combinations four times. In each trial the subjects delivered three different estimates, two interval estimates, Ψ_l and Ψ_u, corresponding to the same credibility level as in study A and in addition a point estimate.

Study C

Study C differs from the other two studies in that a magnitude production technique was applied. The subjects were required to adjust a variable so that it was perceived to stand in a prescribed relation to the standard. The continua used for the adjustments were circle area (Condition I) and loudness of sinusoidal tones (Condition II). Seven different numerical ratios were used as standards (together with a standard circle area and a standard loudness, respectively). The number of subjects in each condition was ten and the number of replications was four. In each trial the subjects presented three reproductions, two "interval productions" (with the same credibility level as above) and a "point production".

R e s u l t s

The technique used to elucidate the hypotheses is straightforward. The relation between the variability of the logarithmized point estimates, $s_{\log\Psi}$, and the ratios between the interval estimates, Ψ_l/Ψ_u, is to be studied by a correlation approach. For the linear version of the description, $y = \beta x + \alpha$, the correlation between our two indices is calculated in linear coordinates, i.e. x is replaced by $s_{\log\Psi}$ and y by Ψ_l/Ψ_u. For the exponential version, $y = \alpha e^{\beta x}$, the correlation is derived from semi-logarithmic coordinates. A logarithmic transformation is here necessary to obtain a linear function between two indices, i.e. $\ln y = \beta x + \ln \alpha$. $s_{\log\Psi}$ is thus used as the x-coordinate as in the former version, while the ratio Ψ_l/Ψ_u is logarithmically transformed.

This is done for each subject participating in our three experiments. His data are then described by a linear and exponential function. The focus of interest for both functions is directed to the α-constants and the product-moment correlation coefficients. The β-constant is of minor interest since it only conveys the slope of the function for which we have no hypothesis. The sign of the slope, which is of importance here, is given by the correlation coefficient.

In study A the subjects estimated the intensity and duration of eight different tones. There were six different conditions with 20 subjects in each. Hence there were 120 different individual sets of data in this experiment and a linear and an exponential function have to be fitted

Condition I					Condition II					Condition III				
Subject	Linear model		Exponential model		Subject	Linear model		Exponential model		Subject	Linear model		Exponential model	
	r	α	r	α		r	α	r	α		r	α	r	α
5	-0.37	0.72	-0.35	0.72	2	-0.86	0.58	-0.85	0.60	1	-0.75	0.73	-0.74	0.74
8	-0.69	0.81	-0.71	0.82	3	-0.51	0.78	-0.49	0.80	4	-0.94	0.56	-0.93	0.57
10	-0.51	0.89	-0.51	0.89	6	0.09	0.41	0.13	0.40	7	0.08	0.59	0.07	0.59
12	0.01	0.88	0.00	0.89	11	0.31	0.47	0.33	0.47	9	-0.70	0.69	-0.70	0.68
15	0.49	0.51	0.47	0.51	17	0.46	0.38	0.55	0.34	13	0.56	0.26	0.50	0.26
16	-0.68	0.86	-0.67	1.51	18	0.44	0.51	0.43	0.52	14	-0.23	0.14	-0.32	0.14
23	0.65	0.35	0.68	0.35	20	-0.89	0.84	-0.89	0.87	19	-0.27	0.66	-0.16	0.56
24	-0.67	0.41	-0.65	0.71	22	-0.18	0.62	-0.15	0.61	21	-0.24	0.52	-0.19	0.51
27	0.43	0.32	0.62	0.32	26	-0.15	0.37	0.21	0.35	25	0.62	0.43	0.62	0.44
28	0.21	0.27	0.21	0.28	33	0.28	0.41	0.34	0.38	29	-0.41	0.56	-0.41	0.57
30	0.80	0.27	0.81	0.27	34	0.30	0.49	0.29	0.49	31	0.57	0.22	0.60	0.21
32	-0.74	0.79	-0.73	0.80	35	-0.54	0.63	-0.50	0.62	36	0.24	0.10	0.34	0.06
42	-0.60	0.67	-0.59	0.68	37	-0.16	0.38	0.06	0.34	38	0.73	0.26	0.71	0.28
44	-0.11	0.67	-0.10	0.66	40	-0.67	0.80	-0.69	0.82	39	0.11	0.74	0.12	0.73
45	-0.66	0.41	-0.66	0.44	41	0.09	0.37	0.08	0.37	46	-0.90	0.69	-0.90	0.69
48	-0.61	0.90	-0.59	0.95	43	0.46	0.31	0.47	0.31	47	0.56	0.44	0.57	0.46
51	-0.02	0.77	-0.03	0.77	49	-0.45	0.57	-0.40	0.57	50	-0.83	0.92	-0.84	0.87
54	-0.33	0.49	-0.26	0.47	52	-0.37	0.58	-0.39	0.57	53	-0.14	0.23	0.20	0.23
56	0.52	0.76	0.52	0.76	55	0.31	0.42	0.40	0.40	59	-0.71	0.54	-0.71	0.57
57	0.85	0.25	0.82	0.29	58	0.31	0.27	0.34	0.25	60	-0.46	0.59	-0.44	0.58
M	-0.11	0.49	-0.09	0.50		-0.13	0.51	-0.09	0.50		-0.26	0.42	-0.24	0.42

Table 1a. Obtained parameters in the two models for each subject in study A for the continuum of duration. In addition the arithmetic means of the parameters are conveyed (for the correlations via Fisher's z_r).

Condition IV					Condition V					Condition VI				
Subject	Linear model		Exponential model		Subject	Linear model		Exponential model		Subject	Linear model		Exponential model	
	r	α	r	α		r	α	r	α		r	α	r	α
2	-0.64	0.57	-0.63	0.57	1	-0.25	0.63	-0.28	0.63	3	0.08	0.55	0.09	0.53
4	-0.34	0.59	-0.34	0.59	7	-0.09	0.60	-0.10	0.60	5	-0.46	0.70	-0.45	0.70
9	-0.77	0.72	-0.76	0.75	8	-0.30	0.92	-0.32	0.93	6	0.63	0.36	0.65	0.36
11	-0.69	0.85	-0.69	0.87	10	0.05	0.83	0.04	0.83	12	0.05	0.63	0.04	0.62
13	0.46	0.30	0.50	0.29	14	-0.63	0.41	-0.66	0.42	15	0.52	0.17	0.55	0.17
17	-0.77	0.59	-0.80	0.59	16	-0.19	0.53	-0.20	0.53	18	-0.71	0.72	-0.70	0.73
20	-0.18	0.47	-0.20	0.47	19	0.32	0.57	0.28	0.58	22	-0.25	0.62	-0.24	0.62
21	-0.12	0.69	-0.12	0.69	24	0.66	0.46	0.66	0.47	23	-0.33	0.72	-0.31	0.73
25	0.35	0.59	0.38	0.58	28	-0.44	0.52	-0.41	0.51	26	0.40	0.43	0.40	0.42
31	-0.11	0.52	-0.10	0.51	29	-0.30	0.39	-0.33	0.39	27	0.18	0.56	0.17	0.56
34	-0.68	0.64	-0.65	0.64	30	-0.44	0.67	-0.40	0.66	32	-0.34	0.61	-0.42	0.63
35	-0.83	0.81	0.83	0.82	36	-0.45	0.51	-0.37	0.48	33	-0.54	0.44	-0.50	0.44
41	-0.57	0.79	-0.53	0.79	38	-0.42	0.54	-0.42	0.54	37	0.39	0.26	0.43	0.26
43	-0.51	0.83	-0.50	0.78	39	-0.70	0.76	-0.71	0.76	40	-0.74	0.70	-0.73	0.70
46	0.03	0.64	0.03	0.63	42	-0.63	0.69	-0.60	0.69	44	0.01	0.64	0.01	0.64
47	0.03	0.58	0.05	0.57	48	-0.23	0.46	-0.23	0.46	45	0.17	0.35	0.17	0.35
49	-0.55	0.59	-0.53	0.59	51	0.08	0.76	0.07	0.76	52	0.05	0.48	0.06	0.48
50	-0.29	0.81	-0.29	0.81	56	-0.79	0.80	-0.76	0.79	54	-0.11	0.44	-0.13	0.44
53	-0.70	0.60	-0.68	0.62	59	-0.89	0.60	-0.87	0.68	55	0.39	0.43	0.40	0.44
58	-0.35	0.56	-0.36	0.56	60	-0.66	0.74	-0.63	0.74	57	-0.49	0.76	-0.48	0.76
M	-0.44	0.64	-0.43	0.64		-0.38	0.62	-0.35	0.62		-0.07	0.54	-0.06	0.53

Table 1b. Obtained parameters in the two models for each subject in study A for the continuum of loudness. In addition the arithmetic means of the parameters are conveyed (for the correlations via Fisher's z_r).

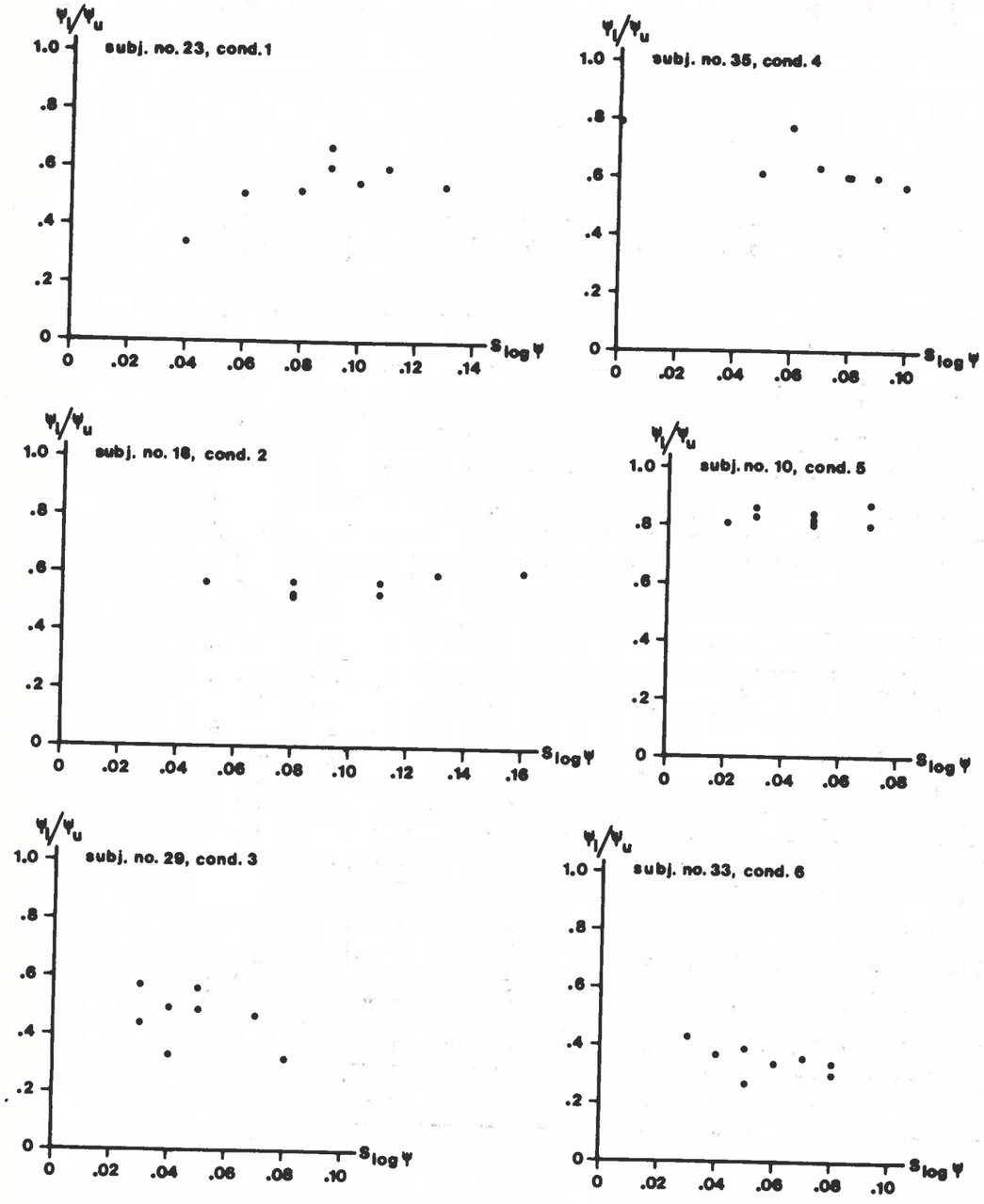

Figure 1. A sample of individual plots from study A relating the variability of logarithmized point estimates and the precision of credible intervals.

to each of these sets of data. The correlation coefficients and the α-constants are presented in Table 1a and 1b and a sample of individual function are depicted in Figure 1.

According to our basic hypothesis there should be a negative relationship between the variability of point estimates and the precision of the credible intervals. This fact should emerge in the fit of data to our functions. When inspecting Table 1 it is immediately seen that, contrary to the hypothesis a considerable portion of the correlations are positive. Approximately one-third of the correlations are positive both in the linear and exponential case. Thus, the hypothesis only receives partial support.

There is a slight tendency for the level of the correlations derived from the linear case to be higher than that of the exponential, i.e. the fit should be somewhat better for the linear case. This is seen from the means of the correlations for each condition. However, the similarity in degree of fit is more impressing. For practical purposes either of the functions might be used to describe the relation between the variability and the width of the intervals.

As regards the α-constant, it is important to notice its numerical level. According to the hypothesis that the same information is to be expressed by the uncertainty indices, α should correspond to 1.0. If it is lower than 1.0, it implies that the subject may feel uncertain in spite of a non-variability in the point estimates to the same stimulus. A value above 1.0 might be generated if the subject for some, but not for all, stimuli feels certain about the appropriate response, but with a certain amount of variability in each case. However, since the α-parameter may be an extrapolated value, α might be $\geq$ 1.0 even if the empirical data show no zero variability or complete precision. There might then be innumerable ways in which the α-parameter could be equal to, or above, unity.

From Table 1 it is obvious that the α value is generally lower than 1.0. Only in one case is a value obtained that exceeds 1.0 and in no case does it correspond exactly to this value. It is true that a positive correlation necessitates an α constant lower than 1.0 so this result is partially implied by the direction of the correlation. Disregarding

the positive correlations, it is obvious that a momentary uncertainty felt by the subjects in each trial cannot be precluded given that variability in repeated estimates is nil.

Summarizing the results from study A it can be concluded that an identical process does not seem to be responsible for the variability of point estimates and the width of credible intervals. The correlations obtained differ significantly from -1.0 and the α constants deviate clearly from 1.0. There is a slight tendency that a linear function has a better fit to the data as compared to an exponential function, but this seems to be of minor importance. The two uncertainty indices, although not identical, may have some factors in common, however, since there was a negative relation between the variability and the precision of the intervals for most subjects.

In study B, 20 subjects estimated the length of six lines in all 36 possible combinations. The results for the individual sets of data are shown in Table 2 with some representative plots in Figure 2. Here it is evident that there is a negative relation between the variability and the precision of the intervals for each subject. Our basic hypothesis thus receives some support from these data. However, the correlations deviated significantly from -1.0, the means of the individual correlations are approximately -0.50, so the indices can by no means be interpreted as representing the same mental processes. However, it seems indubitable that they have something in common.

As in study A, there is a somewhat better fit to the linear model than to the exponential. The size of this difference is numerically small, but clearly significant ($t = 3.30$, $p < .01$).

The α constants are below 1.0 for every subject. Thus the alternative hypothesis is possible that subjects may feel uncertain though this may not be shown in the variability of the estimates. In this respect there is close agreement between studies A and B. The mean of the individual α constants is somewhat below 0.80.

Table 2. Obtained parameters for the two models for the subjects in study B.

Subject	Linear model		Exponential model	
	r	α	r	α
1	-0.58	0.76	-0.54	0.75
2	-0.58	0.84	-0.56	0.84
3	-0.38	0.69	-0.31	0.68
4	-0.67	0.89	-0.67	0.90
5	-0.47	0.80	-0.52	0.88
6	-0.69	0.86	-0.69	0.88
7	-0.68	0.66	-0.62	0.67
8	-0.48	0.74	-0.47	0.74
9	-0.58	0.85	-0.56	0.85
10	-0.31	0.64	-0.26	0.62
11	-0.28	0.83	-0.28	0.83
12	-0.56	0.89	-0.55	0.89
13	-0.48	0.81	-0.46	0.80
14	-0.65	0.92	-0.65	0.92
15	-0.61	0.83	-0.60	0.83
16	-0.19	0.86	-0.11	0.84
17	-0.61	0.56	-0.55	0.59
18	-0.56	0.82	-0.52	0.81
19	-0.56	0.79	-0.53	0.80
20	-0.53	0.68	-0.54	0.68
M	-0.54	0.79	-0.51	0.79

Since there seems to be a uniform relationship between the variability and the precision of the intervals for all the subjects in this experiment, it is reasonable to conjoin the individual data. Hence arithmetical means of $s_{\log\Psi}$ and Ψ_l / Ψ_u were calculated for each stimulus over subjects. The outcome is shown in Figure 3. The fit to the linear as well as to the exponential function is good, better than for most individual subjects. Here there is an obvious negative relationship between the variability index and the precision index. As the case for all subjects the α constant is lower than 1.0, but it is rather high, approximately .90.

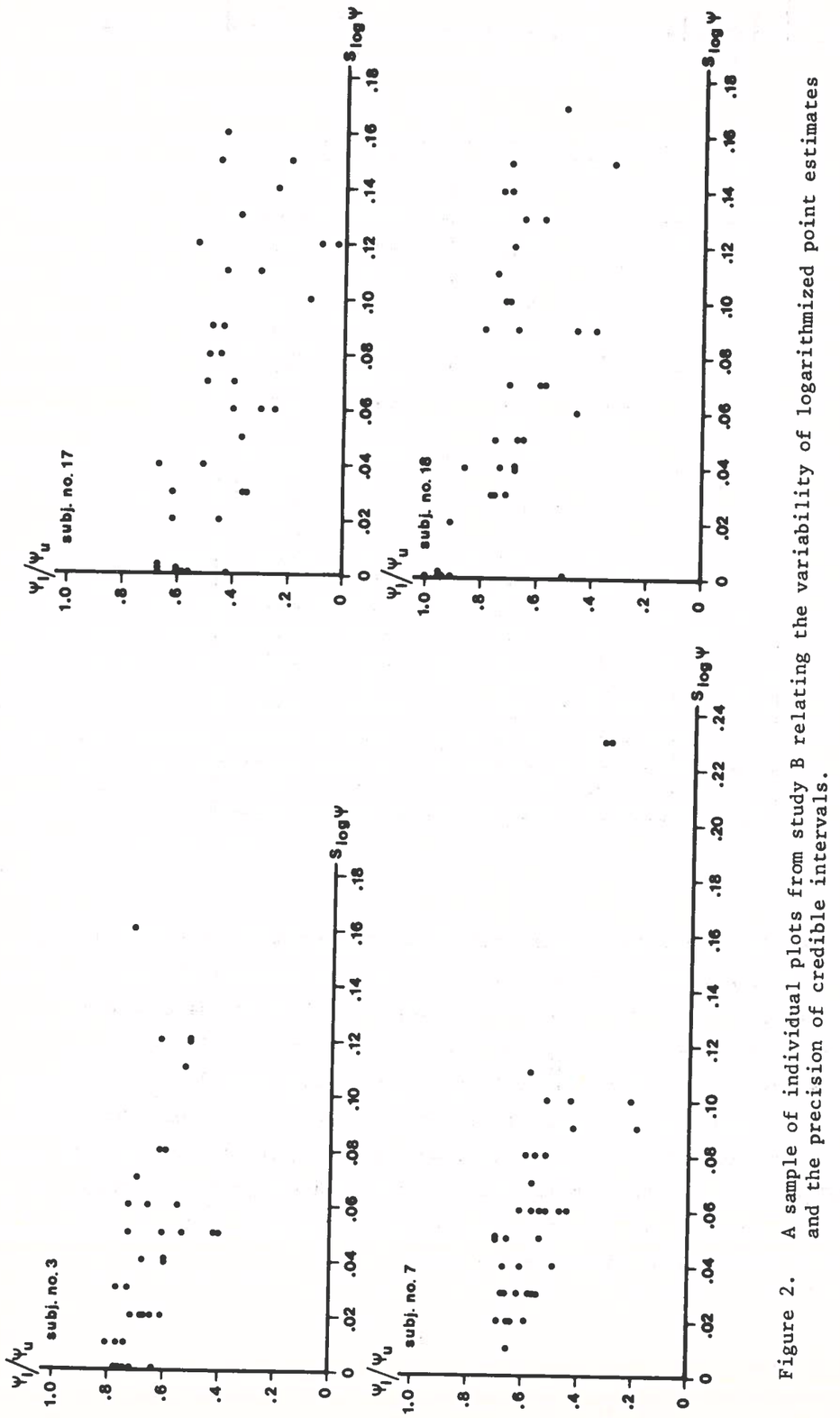

Figure 2. A sample of individual plots from study B relating the variability of logarithmized point estimates and the precision of credible intervals.

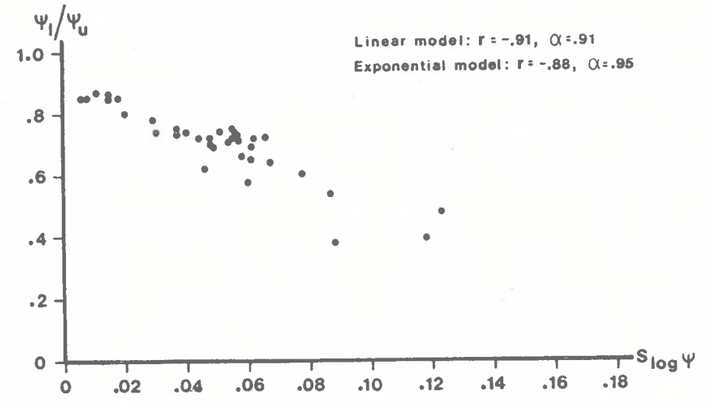

Figure 3. A plot from study B relating variability of logarithmized point estimates and precision of credible intervals. The plot is based on the arithmetical means of individual variability and precision indices at each stimulus combination.

Thus, study B gives some support to the assumption that the variability of point estimates reflects the momentary uncertainty felt by the subjects. There is a clear negative relation between the two indices used. On the other hand, it is also evident that the functions applied always coincide with the y-axis at a level below 1.0, which indicates that the two indices do not give quite congruent information.

The last empirical set of data, study C, is obtained from a magnitude production technique. Ten subjects produced "point productions" and "interval productions" for circle area and loudness for seven stimuli. The results can be seen in Table 3 och Figure 4.

The individual data in this study shows no uniform tendency. Some relationships are positive, while the opposite is true for the majority of the subjects. For most subjects the correlations are quite moderate, somewhat higher for the linear model as compared to the exponential. The results here afford only weak support, if any, to the basic hypothesis.

For all subjects, the α constant is lower than unity in both the linear and the exponential case. As in the other two studies, this suggests that zero variability does not preclude a momentary uncertainty.

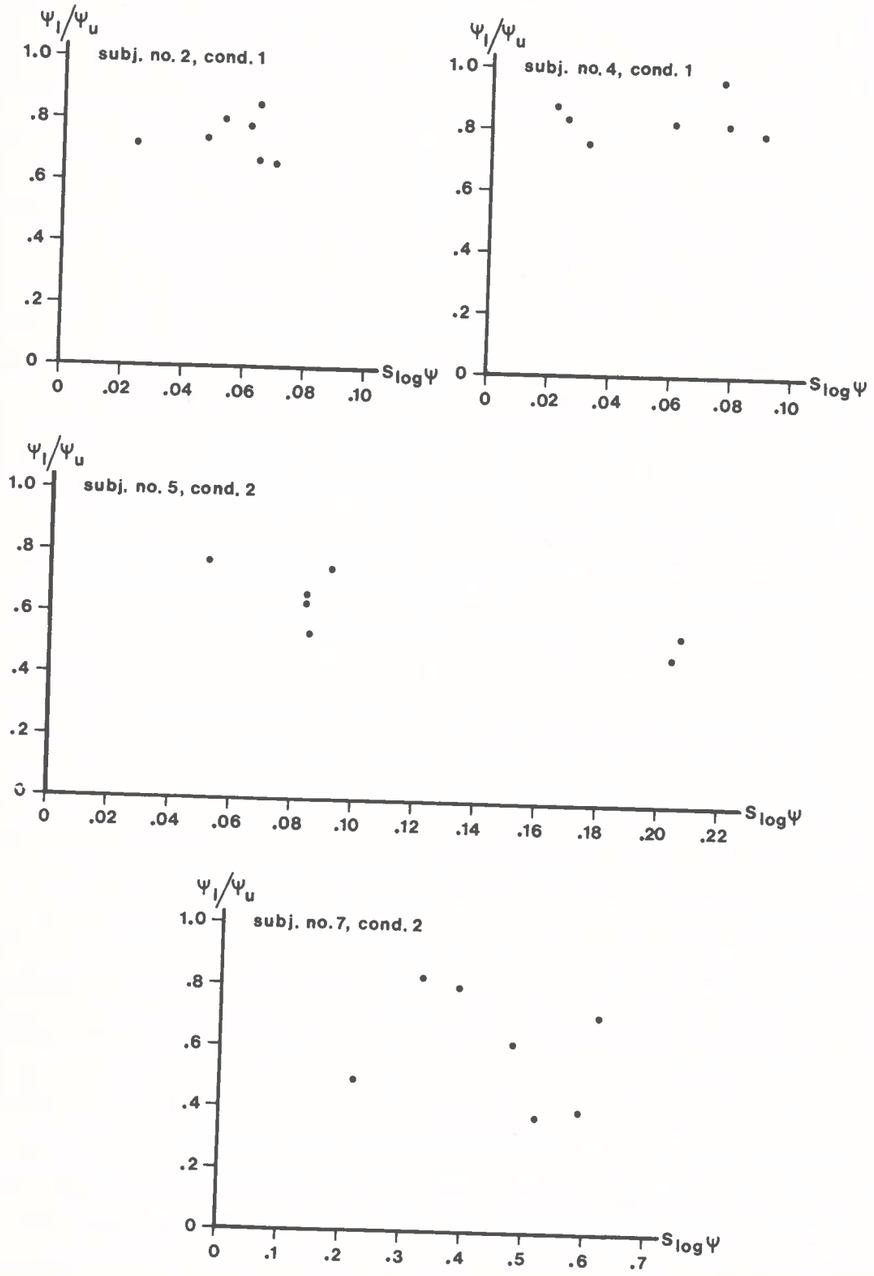

Figure 4. A sample of individual plots from study C relating the variability of logarithmized point estimates and the precision of credible intervals.

Table 3. Obtained parameters in the two models for the subjects in study C.

	Condition I				Condition II			
Subject	Linear model		Exponential model		Linear model		Exponential model	
	r	α	r	α	r	α	r	α
1	-0.10	0.88	-0.13	0.88	0.15	0.53	0.20	0.50
2	-0.01	0.01	-0.03	0.75	-0.55	0.63	-0.20	0.42
3	-0.37	0.77	-0.40	0.78	-0.22	0.79	-0.17	0.72
4	0.16	0.81	0.15	0.82	0.39	0.71	0.30	0.73
5	-0.37	0.76	-0.36	0.76	-0.75	0.78	-0.76	0.80
6	0.12	0.64	0.15	0.63	-0.42	0.76	-0.57	0.82
7	-0.78	0.95	-0.77	0.96	-0.23	0.74	-0.23	0.73
8	0.11	0.81	0.10	0.81	0.40	0.60	0.47	0.54
9	0.03	0.53	0.05	0.53	-0.07	0.28	-0.08	0.27
10	0.40	0.58	0.42	0.58	-0.38	0.65	-0.29	0.62
M	-0.11	0.75	-0.11	0.75	-0.20	0.70	-0.16	0.62

Discussion

According to the basic hypotheses, that the same processes are responsible for variability of point estimates and the width of credible intervals, the inference was made that the two indices $s_{log\Psi}$ and Ψ_l/Ψ_u should be negatively related. This relationship might be described by a linear model $y = \beta x + \alpha$ or an exponential model $y = \alpha e^{-\beta x}$. It was further argued that the α constant should coincide with 1.0 if the two indices should present the same information.

From the empirical data it may safely be concluded that the processes behind the two uncertainty indices are not identical. The relationship was positive for about a third of all the subjects involved and for those subjects where the relation was negative, the fit to either model was far from perfect. Thus the basic assumption seems false.

Regarding the regression problem of predicting the ratio of interval bounds of the credible intervals from variability in the point estimates it was found that the best predicted value, according to a least square criterion, was less than unity when variability was zero. This fact indicated that a momentary uncertainty still is possible although there is no variability. Such a view is also consonant with the 30 indiviual data sets where a zero variability was empirically obtained and not just an extrapolated value. In each of these thirty cases a ratio lower than unity was observed in connection with zero variability (see e.g. subjects 3, 17 and 18 in Figure 2). It should be noted however, that the α constants have been derived from the regression of credible intervals on variability, and, since there is no obvious causal relationship between the indices, the regression of variability on credible intervals also might be calculated. This would lead to higher α constants since the correlations deviated from -1.0. When α constants were based on slopes corresponding to the "orthogonal regression" (c.f. Hald, 1960, p. 601) for each subject with negative correlations according to the linear model, just 41 per cent obtained a value below unity. This presents a somewhat different picture which is more consistent with the assumption that our two uncertainty indices would convey congruent information. In light of all the other deviations mentioned, however, this gives but a weak support to the assumption of congruity.

Though they are not congruent, it still seems reasonable that the two indices share something in common. For most subjects there was a negative relationship between the indices as assumed, and in one study, study B, this was true of all subjects. There is an inclination to regard this evidence as rather impressive since the individual plots were here based on 36 points versus 8 and 7 in the other two studies. If the group data for study B can be assumed to eliminate some "error variance" in the individual plots, it would indicate how close to the functions it would be possible to come. However, when this was done for study A some "paradoxical" results were obtained. In five out of six conditions the group functions yielded small but positive slopes, which was the case for the majority of the subjects in just one condition. In study C, negative slopes were obtained in both conditions for the group data.

Granted that a common mechanism is responsible for the variability of estimates and the width of the credible intervals, it remains to explain how such a mechanism might work. One explanation might be that the point estimates are sampled from the credible intervals and larger variability for the wider intervals would then result. Such an explanation does not, however, take into consideration the fact that the credible intervals are not invariant over trials but that they also oscillate over time in close correspondance to their point estimates. To reconciliate this with a sampling mechanism would require the assumption of a stable "higher-order-distribution" from which both the point and the interval estimates are sampled. Our credible intervals and the variability of the point estimates would then reflect the widths of these "higher-order-distributions". Such an explanation, however, seems rather far-fetched. Another suggestion might be that the subjects implicitly communicate their momentary uncertainty by altering their estimates to an adequate extent from trial to trial or, vice versus, that the widths of the intervals are based on known variability of their point estimates. Whatever the case, it is important to consider that although it may be argued that the variability of estimates and the width of credible intervals are related to the uncertainty felt by the subject in scaling experiments, there seems to be no obvious, or necessary, common cognitive mechanism behind the indices.

The incompleteness of momentary knowledge also hints at an important problem to be considered regarding the interpretation of the outcome from a trial in a psychophysical experiment. If a subject has responded "A" to a stimulus, this does not imply that "not-A" is inappropriate. In ordinary measurement situations, the extension of "A" is known (to a certain probability), e.g. it is often assumed that the last number in a result is uncertain. Such conventions are usually lacking in direct scaling methods, an inconvenience that may be remedied by credible intervals or by asking for "second best" estimates.

Evidence has been presented that knowledge of the sensational magnitude is only partial in virtually every trial. But even if it is only partial, this cannot conceal the fact that there is still some knowledge. The credible intervals are not of infinite width and the subjects can reasonably eliminate some response alternatives. Our final comments are related to the problem of encorporating such partial knowledge into a epistemological framework.

If the judgment task in a scaling experiment is regarded as analogous to an ordinary measurement situation, it is feasible to consider it a construction of "homorphisms between empirical relational structures and numerical relational structures" (Kranz, et al., 1971, p. 9). The empirical relational structure is the set of sensations at issue plus some perceived relations on that set, while the numerical relational structure contains the real numbers together with its ordinary relations. Applying a numerical assignment to a sensation implies that there is some similarity between the two relational structures which may be explicated in some "representation theorems".

In magnitude estimation and similar procedures it is assumed that, for the subject, the sensations may be arranged in a structure with ratio scale properties. The subjects are assumed to possess knowledge of the numerical relational structure, i.e. the real number system, to which they can translate their sensations.

Disregarding the lack of empirical support for this hypothesis (see e.g. Eisler, 1960, Hosman, 1972) there is a problem related to an assumption like this one, where it is stated that the subjects have the ability to translate their sensations into the real number system. How is such an ability attained? The real number system may be thought of as an entirely formal system for which there are an infinite number of conventional empirical interpretations. Given two rods with some definite lengths does not imply that there is only one length-relation (with ratio properties) between the two rods, but an infinite number. It is easy to derive two length-relations, both with ratio scale properties, which are monotonic but non-linear to each other as the result of different empirical interpretations of the concept of addition (see Krantz et al. op. cit. p. 87-88). Thus, if there are several possibilities of interpreting the real number system and if it is sensible to rely on reports from the subjects, then the relations between the sensations ought to have been learned from experience and by training in the conventional interpretations offered by society. The inference might be drawn from such a suggestion that there should be a linear relation between sensational magnitude and physical magnitude for the continuum at hand, which is not the case in most instances. A "physical-correlate" theory (see Warren, 1958) might be an alternative in explaining the non-linear psychophysical relations obtained but it has been shown to be insufficient in some cases (Stevens, 1963).

Resorting to the nativistic view that the subjects have a direct apprehension of sensational magnitudes with ratio properties implies adherence to a philosophical attitude held by Ockham among others in his theory of "natural signs" (intentio animae) (see Wedberg, 1958 p. 272). According to this view there is an intuitive and direct apprehension of the character and meaning of mental events that may differ from those offered by various "conventional signs". The feasibility of such a view seems doubtful, particularly since our studies have indicated that this presumed intuition is at best only partial, a very rare point of view in epistemology. The outcome here obviously favors the attitude that knowledge of one´s own sensations is empirically attained and not just intuitively "given", but the attainment of such a knowledge is still a puzzle.

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Abstract card

Hallsten, L. Credible intervals and the variability of estimates: Two indices of uncertainty. Reports from the Institute of Applied Psychology, the University of Stockholm, 1977, No. 76. - In scaling experiments uncertainty is usually handled by means of variability in the responses. Any uncertainty felt by subjects concerning the adequate response to a stimulus may not, however, appear in the variability of the responses. A more appropriate index of this momentary uncertainty is, perhaps, the widths of the "credible intervals", i.e. the intervals formed by two simultaneous estimates, a lower bound and a upper bound estimate, that to some degree of credibility cover the most appropriate response. A variability index and an index based upon credible intervals were compared in data from three direct ratio scaling experiments. In most cases these two indices conveyed some redundant information but they were evidently due to different cognitive processes. Interpretations of these outcomes are discussed as well as the problems of incorporating the results into a reasonable epistemological framework for scaling experiments. It is emphasized that a basic inconvenience in traditional direct scaling procedures is that a response "A" given to a stimulus does not allow the inference that "not-A" is inadequate. This may, however, be avoided by using credible intervals.

Reference card

Hallsten, L. Credible intervals and the variability of estimates: Two indices of uncertainty. Reports from the Institute of Applied Psychology, the University of Stockholm, 1977, No. 76.

REPORTS FROM THE INSTITUTE OF APPLIED PSYCHOLOGY
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A COMPARISON BETWEEN DIFFERENT CATEGORY SCALES FOR EVALUATION OF SUBJECTIVE SYMPTOMS

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CONTENTS

A COMPARISON BETWEEN DIFFERENT CATEGORY SCALES FOR EVALUATION OF SUBJECTIVE SYMPTOMS

GUNNAR BORG AND INGER LINDBLAD

The aim of this investigation was to compare different category acales and to construct one scale to be used generally for ratings of subjective symptoms as a complement to the RPE-scale (i.e. the commonly used scale for Ratings of Perceived Exertion). The symptom studied with all scales was the exertion during work on a bicycle ergometer. 117 subjects participated, divided into four different experimental groups. Scales used were: the RPE-scale, two nine graded category scales which differed in verbal expressions used as anchors at scale points, two ten graded category scales, also differing in expressions used at scale points. The scales were compared as to their linearity with heart rate and as to the correspondence with heart rate and the RPE-scale. It was found that rating behavior was slightly influenced by the choice of verbal expressions placed at scale points. Very high correlations were found between ratings and heart rates for all scales used. It is proposed that one of the ten graded scales should be used as the best complement to the RPE-scale.

Introduction

An important question in medicine and psychology is how an individual perceives different kinds of symptoms. In physical work these symptoms may, among other things, comprise feelings of effort, exertion and fatigue, panting and dyspnea, thermal sensations, aches and pains. Several techniques to obtain reports of subjective symptoms have been developed. One of them, which functions very well in estimating subjective effort and exertion in physical work, consists of a simple category rating-scale developed by Borg (1961, 1962a, b, 1970). This rating method has been shown to function well in clinical work tests (Borg and Dahlström, 1962a, b; Borg and Linderholm, 1967, 1970), and it shows a very good correlation with heart rate (correlation coefficients between

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.70 and .90, see Borg and Noble, 1974). This category scale, the RPE-scale (the scale for Ratings of Perceived Exertion), has over the years been extensively used. It has been found that ratings of perceived intensity have supplied complementary information to objective physiological variables such as heart rate, blood lactate, ECG, oxygen uptake, blood pressure, EMG and many others. Not only in the clinical area have subjective ratings been of value but have also proved to be useful in industrial occupations in receiving information about perceived intensity of exertion in general and in special situations, and of perceived intensity of aches and pains in arms and shoulders (Costa and Gaffuri, 1975; Gamberale and Holmér, 1977; Edgren and Hedlund, 1978).

However, there are some theoretical problems to be considered when quantifying the perceived intensity of symptoms. One overall problem is the difficulty in making inter-individual comparisons, since obtained ratings are relative to the frame of reference of each individual, very much so when using a ratio estimation technique. This problem has been very much neglected by S.S.Stevens and his collaborators. In a study by Stevens and Galanter (1957) the superiority of ratio scaling was shown in general psychophysical studies, and Stevens concludes in one of his last articles (1971) that there is "little to justify the use of category scaling in quantitative studies". This concluding statement, does not, however, according to our point of view do justice to the difficult differential problems and related problems concerning the possibilities to obtain direct estimates of intensity levels. Borg (1961, 1962b, 1970, 1972, 1974) has suggested that the maximal intensity or range of modality, e.g. perceived exertion, is set equal for all individuals and used as a frame of reference. In the study by Borg (1972), a ratio-rating method for interindividual comparisons was tried out and compared with a category-rating method; the subjects' notion of maximal exertion was used as the reference level. The ratio-rating method functioned well with high correlations between heart rates and category ratings. However, ratings of perceived exertion according to the RPE-scale gave higher correspondence with heart rates, showing the superiority of this kind of method.

A ratio-rating technique shows the *relation* between percepts but gives no direct information of the intensity *level*. According to this method

the subjects are expected to be accustomed to using figures and have to be able to think in terms of ratios. What is most often needed, though, are measurements of intensity levels, i.e. degrees of physical stress in a more "absolute" sense. In a category-rating method estimates of intensity levels of interindividual validity may be obtained. At the same time the shortcomings of the ordinal scale can be overcome as the intervals between scale points can roughly be made to appear equidistant by using carefully chosen verbal expressions (Hosman and Borg, 1970). In an investigation by Borg and Liljefors (see Borg, 1973), two experiments comparing four different rating methods showed that good correlations between heart rates and perceived exertion ratings were obtained independently of which scale was used. The scales used were: The RPE-scale, a line scale (where the subjects had to mark the intensity of his perception on an 11 cm line with the poles "no exertion at all" and "maximal exertion"), a 21-graded category scale and a 9-graded scale with the only verbal anchors "not at all stressful" at scale point 2 and at point 8 "very, very stressful". It was also seen that the RPE-scale gave highest correlations to heart rate and that the line scale gave slightly lower correlation (significant difference at $p \leq .20$). Even a 9-graded scale with only two verbal points gave lower correlations to heart rate, compared with a 21-graded scale with verbal expressions the difference was significant also at $p \leq .20$, the 21-graded scale giving somewhat higher correlations. This supports the idea that a verbal category scale is most useful.

The reliability of the scaling method is influenced both by the number of categories used, according to Lisstz and Green (1975), as well as by the verbal expressions placed at scale points as pointed out above (Borg, 1962b, 1964; Hosman and Borg, 1970; Montgomery, 1971; Montgomery and Eisler, 1972).

In order to receive information on how individuals perceive everyday verbal expressions used as quantifiers a study was made by Borg and Lindblad (1976) where subjects differing in educational background, age, occupation and language, were asked to estimate subjectively the expressions commonly used in category scales. The conception of a certain exertion level was used as reference to which the subjects were asked

to rate the verbal expressions. Mean values for rated expressions were used as measurements of "interpretation" and standard deviations and coefficients of variance were used as measures of "preciseness". Ratings of the different groups coincided very well in spite of their differences in background. Three different category scales, one nine-graded and two ten-graded were designed on the basis of this investigation.

Even if the RPE-scale has proved to function well in many investigations it has, however, also som drawbacks. One of them is that the distribution of ratings given is slightly uneven as subjects tend to use scale points with verbal anchors if instructions are not carefully given. The other drawback concerns the misuse of the relation between RPE-values and heart rates, i.e. the relation consisting of HR=10xRPE (Borg, 1962 a). This equation was only meant as a rough description of a relation that was to function in a group of middle aged people doing physical work on bicycle ergometer. In younger and older people and in various groups of patients as well as in other work situations, this is not the case.

The aim of the present investigation was to compare some different category scales and to design one scale to be used as a substitute or complement to the RPE-scale and to be used generally for ratings of subjective symptoms in various situations. In these studies the relation of the scale values to RPE-ratings and to heart rates are important criteria. It has also been considered to be of interest to report, more closely, the relation between the different scales to enable simple transformation from one scale to the other, as two of the nine-graded scales have been used in clinical work, as has also the RPE-scale.

The scales used are:

1. The RPE-scale
2. A nine-graded category scale used for ratings of subjective symptoms (Borg, Karlsson, Lindblad, 1976) (C9-gr)
3. A nine-graded semantically constructed scale (S9-gr)
4. A ten-graded semantically constructed scale (S10-gr)
5. An alternative ten-graded semantically constructed scale (Sn 10 -gr)

M e t h o d

The investigation was carried out on a total group of 117 male subjects both physically active and inactive. They belonged to four experimental groups tested on different occasions.

A work test was carried out according to the testing procedure developed by Sjöstrand and Wahlund (1947, 1948). Work loads of 120 (≃ 20 watt), 240 (40 w), 360 (60 w) and 600 kpm x min^{-1} (100 w) with a subsequent increase of 300 kpm x min^{-1} (50 w) at working periods of six minutes on each load were used in two of the groups (see Table 1 and 2). Those subjects had been tested earlier where information about maximal heart rate was received. Work load of 150 (24 w), 300 kpm x min^{-1} (50 w) with an increase of 300 kpm x min^{-1} (50 w) at working periods of six minutes were used in one group (see Table 4). In another experimental group all subjects started on a work load of 300 kpm x min^{-1} (50 w), then, depending upon the subject's physical status, work loads of 600 (100 w), 900 (150 w) and 1200 kpm x min^{-1} (200 w) were used in the less fit group, 900 (100 w), 1200 (200 w) and 1500 kpm x min^{-1} (250 w) were used in the more normally fit group and 1200 (200 w), 1500 (250 w) and 1800 kpm x min^{-1} (300 w) with the most fit subjects. Working periods were six minutes on each load. The distribution of work loads in this group has been made with allowance made for working capacity earlier tested where oxygen uptake was received, in order to make possible a shorter testing period (see Table 3). In all groups the testing was interrupted when the subjects had reached a heart rate of 170 beats/minute or could no longer continue.

At the end of every working period measures of heart rate were made using a tachtometer which made successive readings possible. The subjects were also asked to rate their perceived exertion, according to the rating scales. The scales were presented in alternate order.

Subjects in experimental group I consisted of students in physical education, all well trained and with experience from this type of experiment and of ratings of perceived exertion.

Table 1. Means (M) and standard deviations (SD) in the variables age (years), height (cm), weight (kg) and maximal heart rate (max. HR, beats/min) and rating scales used in experimental group I (N=18).

		Age	Height	Weight	Max.HR	Scales used
Exp.gr. I	M	25.6	182.1	74.7	191.1	RPE-scale
	SD	3.8	6.9	5.7	7.4	S9-gr; S10-gr

In experimental group II students in physical education, well trained and having experience from this type of ergometer work and ratings, took part.

Table 2. Means (M) and standard deviations (SD) in the variables age (years), height (cm), weight (kg) and maximal heart rate (max.HR, beats/min) and rating scales used in experimental group II (N=17).

		Age	Height	Weight	Max.Hr	Scales used
Exp.gr.II	M	27.3	184.1	74.8	201.1	RPE-scale
	SD	5.3	7.2	9.1	12.2	C9-gr; S10-gr

Subjects in experimental group III were military conscripts of the engineer corps not used to this type of experimental situation. They were divided into three groups according to physical status, based on results from earlier tests of physical working capacity.

Table 3. Means (M) and standard deviations (SD) in the variables age (years), height (cm), weight (kg), estimated maximal oxygen uptake (a) 1/min and (b) ml/kg x min^{-1} and scales used in group A (N=25), group B (N=21) and group C (N=10).

Exp.gr.III		Age	Height	Weight	Est.max.ox.uptake a)	b)	Scales used
Gr A	M	19.9	180.4	72.8	2.9	39.9	C9-gr
	SD	0.7	7.4	7.7	0.2	4.9	S9-gr
Gr B	M	20.0	187.4	76.8	3.5	45.5	C9-gr
	SD	1.2	6.4	7.3	0.3	5.3	S9-gr
Gr C	M	21.5	182.6	78.5	4.2	53.3	C9-gr
	SD	3.9	7.1	5.1	0.4	4.7	S9-gr

Experimental group IV consisted of relatively untrained subjects with no experience at all of work tests and ratings of perceived exertion.

Table 4. Means (M) and standard deviations (SD) in the variables age (years), height (c) and weight (kg) and rating scales used in experimental group IV (N=26).

		Age	Height	Weight	Scales used
Exp.gr.IV	M	26.8	182.4	75.4	RPE-scale
	SD	4.4	6.3	7.2	C9-gr, Sn10-gr

The ten-graded scale (Sn10-gr) used in the experimental group IV was designed on the basis of the results obtained in experimental group III.

Two groups of 20 subjects each, one group consisting of psychologists, the other of students in courses given by the Labor Market Board, were asked to estimate the subjective intensity of verbal expressions used in category scales. The test material consisted of nine commonly used expressions, four already tested in an earlier investigation, see Borg and Lindblad (1976). The subjects received a response booklet with as many pages as words presented and were asked to rate one expression at a time. On each page a twenty centimeter vertical line with the poles "Nothing at all" and Maximal" was drawn and the question "How strong is your feeling of exertion?" was written above.

The subjects were instructed to imagine themselves running as much as they could for fifteen minutes in order to reach a maximal exertion. Their ideas of maximal exertion and no exertion at all should function as a frame of reference. The subjects were to rate the nine expressions in terms of a certain degree of perceived exertion, indicated by the expressions presented, and write down and mark where on the vertical line the word could be placed.

R e s u l t

Means and standard deviations for heart rates and ratings of perceived exertion at each work load level in experimental groups I, II and III are shown in Tables 5a-d.

Table 5a. Means (M) and standard deviations (SD) for the variables heart rate (HR) and ratings of perceived exertion according to the RPE-scale, S9-gr, S10-gr scales at work load levels (kpm x min^{-1}) in experimental group I (N=18).

work load level / variables		REST	120	360	600	900	1200
HR	M	73.24	84.12	94.12	107.29	124.41	145.30
	SD	7.72	6.47	6.81	8.04	10.93	13.24
RPE	M	6.24	7.00	8.53	10.29	13.06	15.12
	SD	0.44	1.12	2.10	2.34	1.89	1.88
S9-gr	M	0.12	0.76	1.76	2.82	4.18	5.20
	SD	0.33	0.75	1.03	1.24	0.81	0.93
S10-gr	M	0.24	0.82	1.82	2.76	4.41	5.71
	SD	0.56	0.81	1.19	1.20	1.06	1.26

Table 5b. Means (M) and standard deviations (SD) for the variables heart rate (HR) and ratings of perceived exertion according to the RPE-scale, C9-gr, S10-gr scales at work load levels (kpm x min^{-1}) in experimental group II (N=17).

work load level / variables		REST	120	360	600	900	1200
HR	M	74.31	83.56	94.89	111.33	130.67	151.39
	SD	9.44	9.31	8.01	7.68	11.99	12.92
RPE	M	6.19	6.94	8.95	10.72	14.22	16.11
	SD	0.54	0.94	1.66	1.64	1.22	1.18
C9-gr	M	0.19	0.78	1.72	3.11	4.11	5.50
	SD	0.54	0.65	0.89	0.68	0.76	0.79
S10-gr	M	0.19	0.83	1.94	3.44	4.61	6.33
	SD	0.54	0.62	0.94	0.98	0.92	0.84

Table 5d. Means (M) and standard deviations (SD) for the variables heart rate (HR) and ratings of perceived exertion according to RPE-scale, C9-gr, Sn10-gr scales at work load levels (kpm x min^{-1}) in experimental group IV (N=26).

work load level / variables		Rest	150	300	600	900	1200
HR	M	81.12	86.58	93.04	111.62	134.46	155.44
	SD	11.78	13.43	14.00	13.24	17.32	16.78
RPE	M	6.77	7.81	9.58	12.04	14.27	16.44
	SD	1.27	1.63	2.04	2.14	1.78	1.58
C9-gr	M	0.31	1.12	2.19	3.31	4.46	5.52
	SD	0.55	0.86	1.06	1.01	0.99	0.96
Sn10-gr	M	0.31	1.15	2.19	3.77	5.19	6.52
	SD	0.55	0.78	0.98	1.24	1.17	1.08

Table 5c. Means (M) and standard deviations (SD) for the variables heart rate (HR) and ratings of perceived exertion according to the C9-gr and S9-gr scales at work load levels (kpm x min^{-1}) in experimental group III, group A (N=25), group B (N=21), group C (N=10).

A

variables \ work load level		300	600	900	1200
HR	M	109.71	133.17	154.88	171.50
	SD	9.66	8.90	11.55	8.38
C9-gr	M	1.71	3.21	4.54	5.58
	SD	1.16	0.83	1.14	1.08
S9-gr	M	1.63	3.63	4.88	5.67
	SD	1.10	1.01	0.90	0.98

B

variables \ work load level		300	900	1200
HR	M	101.40	139.32	165.29
	SD	12.32	10.33	10.52
C9-gr	M	1.25	3.95	5.14
	SD	1.02	1.21	1.24
S9-gr	M	1.30	4.18	5.29
	SD	1.08	0.91	0.96

C

variables \ work load level		300	1200	1500
HR	M	99.60	147.33	169.90
	SD	10.60	13.55	10.56
C9-gr	M	1.30	4.00	6.10
	SD	1.06	1.00	1.10
S9-gr	M	1.40	4.67	6.20
	SD	0.84	1.71	0.92

As can be seen from the tables for experimental groups I and II, with well fit subjects used to this type of experiment, ratings well follow heart rate values. In group IV, however, consisting of subjects chosen to be a more representative group, heart rates are higher at the same work loads as used in groups I and II, and so are the ratings given. The ratings, though, are growing linearly with work loads in all groups which can also be seen in Figures 1-12.

Product moment correlations (r_{xy}) between heart rate and perceived exertion based on individual values on work load levels in the four experimental groups respectively are shown in Table 6.

Table 6. Product moment correlations (r_{xy}) between heart rates (HR) and ratings of perceived exertion according to the RPE-scale, C9-gr, S9-gr, S10-gr and the Sn10-gr scales based on individual values on all work load levels in the experimental groups respectively. Exp.gr.I (N=18), Exp.gr.II (N=17), Exp.gr.III (N=56), Exp.gr.IV (N=26).

Exp.gr. I

HR			
RPE	0.917		
S9-gr	0.927	0.981	
S10-gr	0.924	0.982	0.986

Exp.gr. II

HR			
RPE	0.929		
C9-gr	0.912	0.978	
S10-gr	0.911	0.972	0.948

Exp.gr. III

HR		
C9-gr	0.788	
S9-gr	0.811	0.952

Exp.gr. IV

HR			
RPE	0.846		
C9-gr	0.834	0.960	
Sn10-gr	0.862	0.970	0.980

It is here seen that ratings according to the different scales correlate highly with each other in all groups, as well as with heart rates.

Product moment correlation coefficients (r_{xy}) between heart rate and perceived exertion based on individual values on each work load level in all four experimental groups respectively are shown in Tables 7a-d.

Table 7a. Product moment correlations (r_{xy}) between heart rates (HR) and ratings of perceived exertion according to the RPE-scale, S9-gr, S10-gr scales based on individual values on work load levels (kpm x min^{-1}) in experimental group I (N=18).

360 kpm x min^{-1}			
HR			
RPE	0.179		
S9-gr	0.306	0.927	
S10-gr	0.343	0.946	0.985

600 kpm x min^{-1}			
HR			
RPE	0.320		
S9-gr	0.376	0.948	
S10-gr	0.376	0.938	0.980

900 kpm x min^{-1}			
HR			
RPE	0.438		
S9-gr	0.514	0.852	
S10-gr	0.451	0.858	0.926

1200 kpm x min^{-1}			
HR			
RPE	0.523		
S9-gr	0.523	0.925	
S10-gr	0.394	0.906	0.890

Table 7b. Product moment correlations (r_{xy}) between heart rates (HR) and ratings of perceived exertion according to the RPE-scale, C9-gr, S10-gr scales based on individual values on work load levels (kpm x min^{-1}) in experimental group II (N=17).

600 kpm x min^{-1}			
HR			
RPE	0.241		
C9-gr	0.218	0.932	
S10-gr	0.293	0.821	0.742

900 kpm x min^{-1}			
HR			
RPE	0.531		
C9-gr	0.294	0.865	
S10-gr	0.293	0.821	0.742

1200 kpm x min^{-1}			
HR			
RPE	0.466		
C9-gr	0.344	0.886	
S10-gr	0.451	0.789	0.890

Table 7c. Product moment correlations (r_{xy}) between heart rates (HR) and ratings of perceived exertion according to the C9-gr and S9-gr scales based on individual values on work load levels (kpm x min^{-1}) in experimental group III (N=56).

300 kpm x min^{-1}		
HR		
C9-gr	0.047	
S9-gr	0.035	0.921

900 kpm x min^{-1}		
HR		
C9-gr	0.266	
S9-gr	0.235	0.834

1200 kpm x min^{-1}		
HR		
C9-gr	0.463	
S9-gr	0.472	0.896

Table 7d. Product moment correlations (r_{xy}) between heart rates (HR) and ratings of perceived exertion according to the RPE-scale, C9-gr, Sn10-gr scales based on individual values on work load levels (kpm x min^{-1}) in experimental group IV (N=26).

300 kpm x min^{-1}			
HR			
RPE	0.375		
C9-gr	0.339	0.908	
Sn10-gr	0.346	0.902	0.964

600 kpm x min^{-1}			
HR			
RPE	0.344		
C9-gr	0.367	0.880	
Sn10-gr	0.422	0.934	0.918

900 kpm x min^{-1}			
HR			
RPE	0.557		
C9-gr	0.561	0.904	
Sn10-gr	0.620	0.937	0.925

1200 kpm x min^{-1}			
HR			
RPE	0.643		
C9-gr	0.614	0.855	
Sn10-gr	0.586	0.880	0.847

Tables 8 and 9 show the means and standard deviations, and the coefficient of variation for expressions rated by the two groups of subjects differing in educational background.

Table 8. Means (M) and standard deviations (SD) and coefficients of variation (V) for expressions rated on a 20 cm line (N=20).

	M	SD	V
1. Knappt kännbar (Hardly noticeable)	0.85	0.52	61.1
2. Mycket, mycket svag (Very, very weak)	1.10	0.61	55.4
3. Mycket svag (Very weak)	1.96	1.05	53.5
4. Svag (Weak)	3.39	1.82	53.6
5. Tydlig men svag (Evident but weak)	3.67	1.72	46.8
6. Mycket stark (Very strong)	15.25	1.93	12.6
7. Mycket, mycket stark (Very, very strong)	17.17	1.70	9.9
8. Nästan outhärdlig (Nearly unbearable)	18.60	1.41	7.5
9. Outhärdlig (Unbearable) (N=13)	19.68	0.98	4.9

Table 9. Means (M), standard deviations (SD) and coefficients of variation (V) for expressions rated on a 20 cm line (N=20).

	M	SD	V
1. Knappt kännbar (Hardly noticeable)	0.64	0.53	82.8
2. Mycket, mycket svag (Very, very weak)	1.26	1.53	127.4
3. Mycket svag (Very weak)	1.28	0.73	57.0
4. Svag (Weak)	3.78	2.55	67.4
5. Tydlig men svag (Evident but weak)	3.57	3.70	103.6
6. Mycket stark (Very strong)	16.21	2.28	14.0
7. Mycket, mycket stark (Very, very strong)	18.05	1.61	8.9
8. Nästan outhärdlig (Nearly unbearable)	18.94	2.04	10.7
9. Outhärdlig (Unbearable) (N=12)	19.70	0.51	2.5

It is here seen that in spite of the fact that the two groups differ in background they rate the expressions similarly, which supports data received earlier (Borg and Lindblad, 1976). The variation, though, is greater in the second group.

Figures 1, 2 and 3 show the relation between heart rate and perceived exertion according to the RPE-scale in experimental groups I, II and IV respectively.

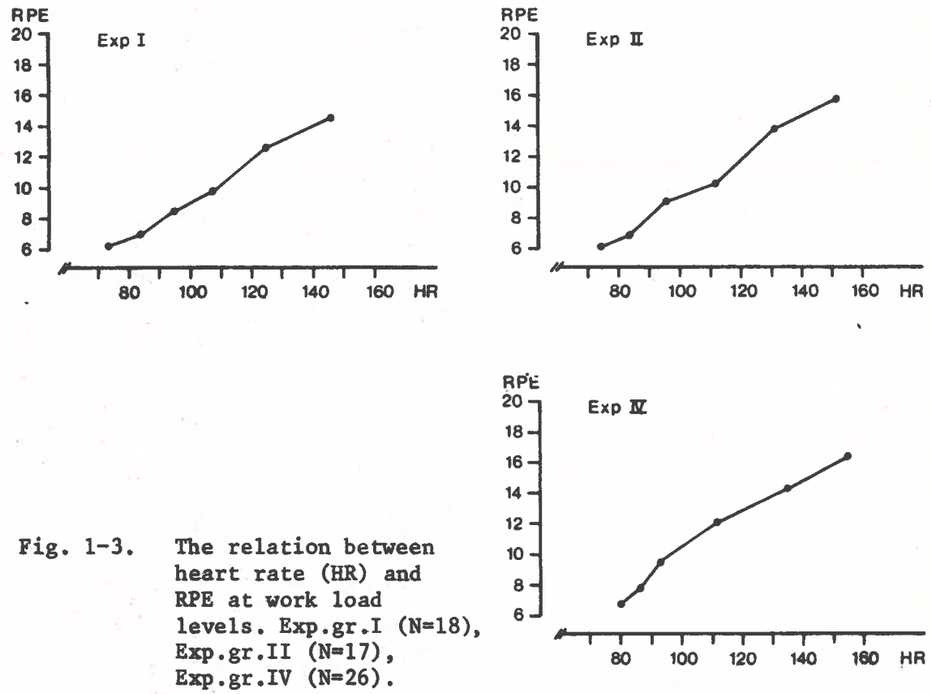


Fig. 1-3. The relation between heart rate (HR) and RPE at work load levels. Exp.gr.I (N=18), Exp.gr.II (N=17), Exp.gr.IV (N=26).

Figures 4, 5 and 6 show the relation between heart rate and perceived exertion according to the S9-graded scale, used in experimental group I and the C9-graded scale used in groups II and IV.

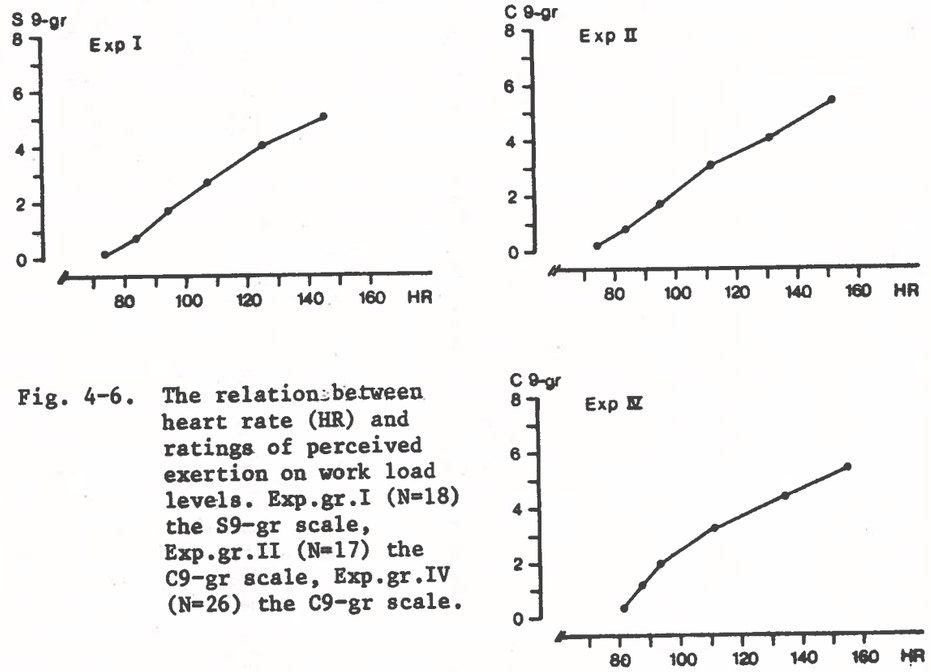


Fig. 4-6. The relation between heart rate (HR) and ratings of perceived exertion on work load levels. Exp.gr.I (N=18) the S9-gr scale, Exp.gr.II (N=17) the C9-gr scale, Exp.gr.IV (N=26) the C9-gr scale.

Figures 7, 8 and 9 show the relation between heart rate and perceived exertion according to the S10-graded scale used in experimental groups I and II and the Sn10-graded scale used in experimental group IV.

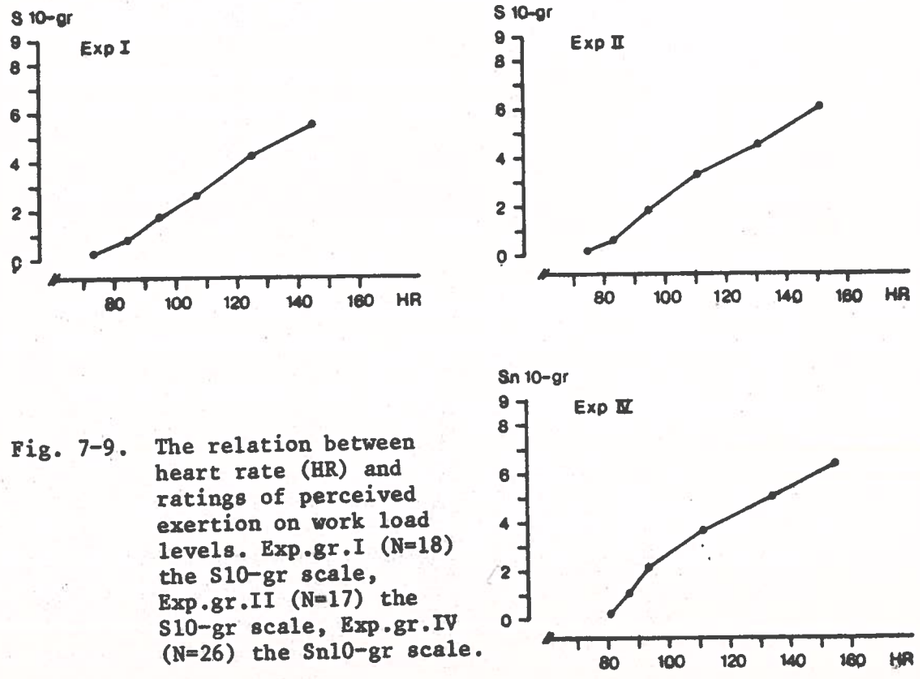


Fig. 7-9. The relation between heart rate (HR) and ratings of perceived exertion on work load levels. Exp.gr.I (N=18) the S10-gr scale, Exp.gr.II (N=17) the S10-gr scale, Exp.gr.IV (N=26) the Sn10-gr scale.

Figures 10, 11 and 12 show the relation between heart rate and ratings of perceived exertion according to the C9-graded and S9-graded scales used in the groups A, B and C of the experimental group III.

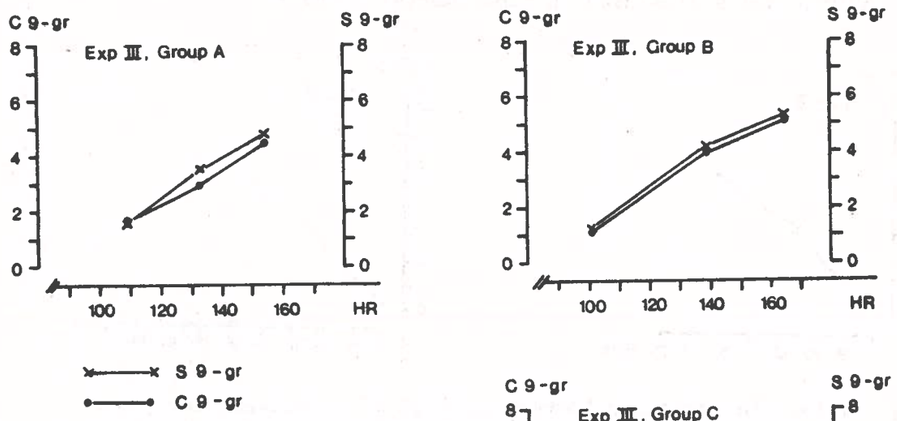
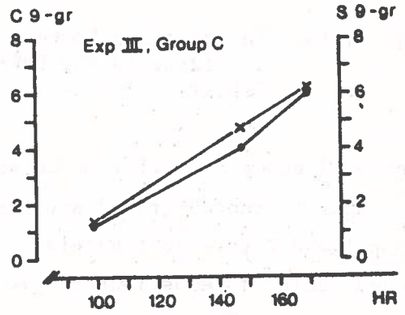


Fig. 10-12. The relation between heart rate (HR) and ratings of perceived exertion according to the C9-gr and the S9-gr scales on work load levels. Group A (N=25) group B (N=21) group C (N=10), Exp.gr. III.



Figures 13 and 14 show the relation between ratings of perceived exertion according to the RPE-scale and according to the S9-graded and S10-graded scales used in experimental group I.

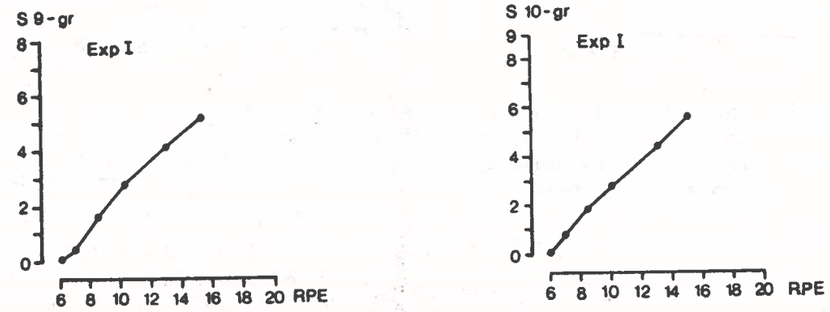


Fig. 13-14. The relation between ratings of perceived exertion according to the RPE-scale, S9-gr and S10-gr scales, Exp. gr. I (N=18).

Figures 15 and 16 show the relation between ratings of perceived exertion according to the RPE-scale and according to the C9-graded and S10-graded scales used in experimental group II.

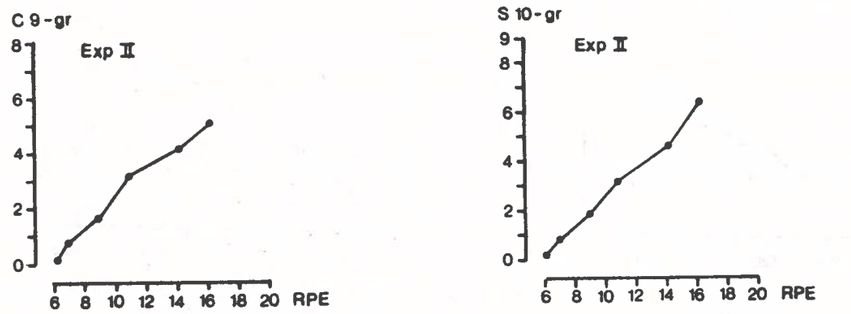


Fig. 15-16. The relation between ratings of perceived exertion according to the RPE-scale, C9-gr and S10-gr scales, Exp.gr. II (N=17).

Figure 17 shows the relation between ratings of perceived exertion according to the S9-graded and the S10-graded scales in experimental group I.and Figure 18 the relation between the C9-graded and the S10-graded scales in experimental group II.

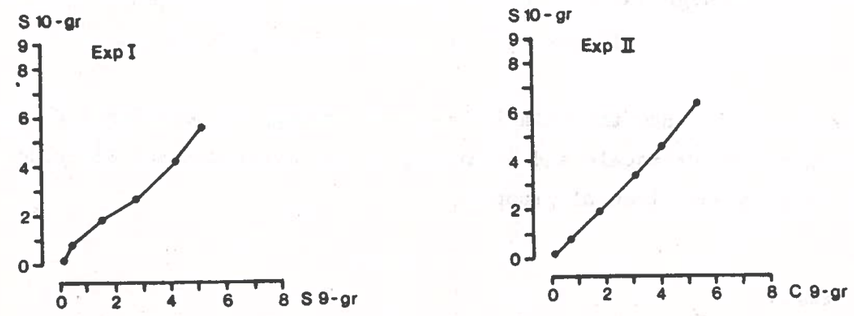


Fig. 17-18. The relation between ratings of perceived exertion according to the S9-gr and the S10-gr scales, Exp.gr.I (N=18); and according to the C9-gr and S10-gr scales, Exp.gr. II (N=17).

Figures 19 and 20 show the relation between ratings of perceived exertion according to the RPE-scale and the C9-graded scale as well as the Sn10-graded scale in experimental group IV.

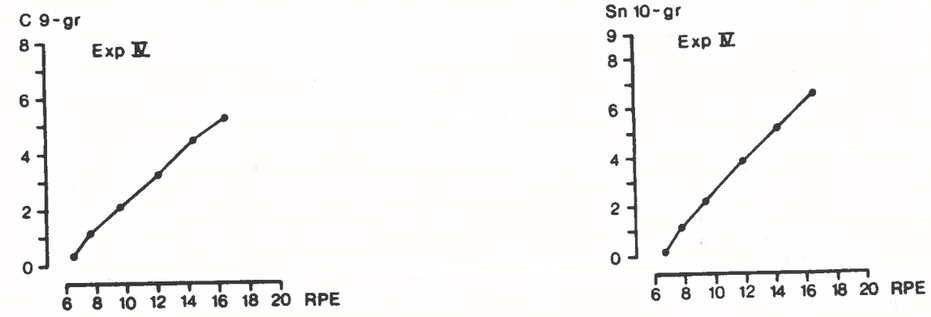


Fig. 19-20. The relation between ratings of perceived exertion according to the RPE-scale and the C9-gr scale; and according to the RPE-scale and the Sn10-gr scale, Exp. gr. IV (N=26).

Figure 21 shows the relation between ratings of perceived exertion according to the Sn10-graded scale and the C9-graded scale in experimental group IV.

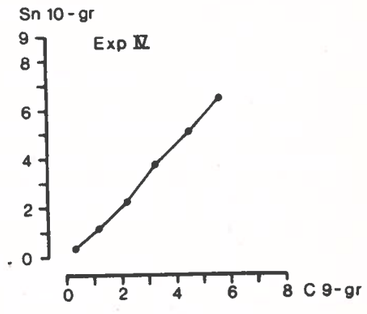


Fig. 21. The relation between ratings of perceived exertion according to the Sn10-gr and C9-gr scale, Exp. gr. IV (N=26).

Figure 22 (see next page) shows the relation between heart rate (HR) and ratings of perceived exertion according to the RPE-scale, the C9-graded and the Sn10-graded scale on work load levels (kpm x min^{-1}) in experimental group IV. The scales are set on an equal range.

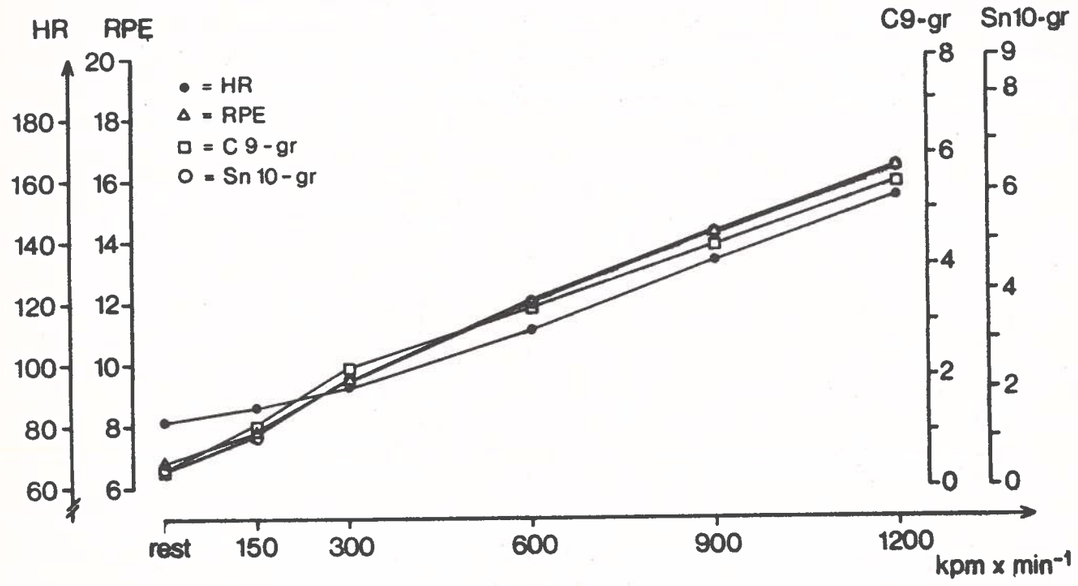


Fig. 22. The relation between heart rate (HR) and ratings of perceived exertion according to the RPE-scale, the C9-gr and the Sn10-gr scale on work load levels (kpm x min^{-1}), Exp.gr. IV (N=26).

Figure 23 shows the frequency of scale values used by subjects in both the S9-graded scale and the C9-graded scale in the experimental group III.

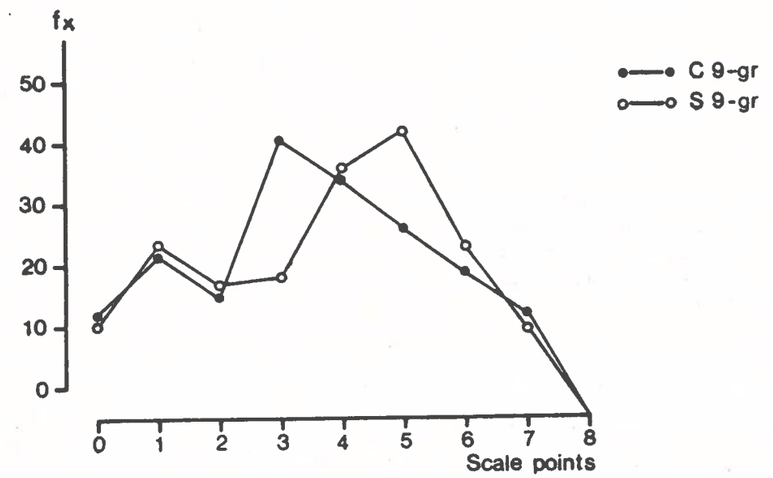


Fig. 23. The frequency of scale values by subjects in the S9-gr and the C9-gr scale, Exp.gr. III (N=56).

On Table 10 a transformation table is presented for making translations to the new ten-graded scale (Sn10-gr) possible from the two nine-graded scales which are now commonly used in clinical practice.

Table 10. Transformation values from the C9-gr scale and the S9-gr scale to the Sn10-gr scale.

C9-gr scale	Sn10-gr scale	S9-gr scale	Sn10-gr scale
0	0	0	0
1	1,1	1	1.4
2	2,2	2	2,4
3	3,4	3	3,5
4	4,5	4	4,6
5	5,6	5	5,7
6	6,7	6	6,8
7	7,9	7	7,8
8	9	8	9

D i s c u s s i o n

In Figures 1-12 can be seen that the rating scales show a good linear relation to heart rate which is of importance when making extra- and intrapolations at submaximal worktests and that the trend of the curves are almost the same for all scales used in the experimental groups.

In Table 6 it is shown that productmoment correlation between heart rate and ratings of perceived exertion according to the RPE-scale, the C9-gr, S9-gr, S10-gr and the Sn10-gr scales are very high in all experimental groups over work loads. No statistically significant differences in correlation to neither heart rate nor RPE-scale are found except in group III where the S9-gr scale has a higher correlation with heart rate than has the C9-gr scale ($p \leq .05$).

In Table 7, where correlations between rating scales and heart rate on each work load are shown, it is found that low correlations are obtained on low working levels but become higher at high levels.

The correlations between the scales are high on all levels, between .74 and .92. In experimental group I the S9-gr scale shows higher correlations to heart rate than does the S10-gr scale. In experimental group II the C9-gr scale shows almost the same correlations with heart rate as does the S10-gr scale. The C9-gr scale in this group has higher correlations with the RPE-scale, which can be explained by the fact that the C9-gr scale is constructed in the same way as the RPE-scale, being non-symmetric.

In Table 7c the two nine-graded category scales´ correlations to heart rate in experimental group III are presented, showing that the scales do not differ in this respect but, as is shown in Figure 21, the scales are used differently when the subjects are giving ratings. In the C9-gr scale the subjects prefer to use number 3 on the S9-gr scale with the expression "rätt svag" ("fairly weak"). It can also be seen that the subjects prefer to use the number 5 with the expression "ganska stark" "rather strong") on the S9-gr scale to the expression "stark" ("strong") on the C9-gr scale. So even if the two category scales have the same amount of categories, the end-points "ingen alls" - "maximal" ("none at all" - "maximal") and a perfect rank order between expressions used as anchors for scale values, the actual verbal expressions used are important for the subject´s choice of rating value.

On the basis of this a new ten-graded scale was designed and used in experimental group IV. Ten categories were chosen in order to make possible more differentiated ratings at higher exertion levels and to construct a non-symmetric scale which has been shown to give a better linearity to heart rate than does a symmetric scale.

In Table 7d it is shown that this ten-graded scale gave higher correlations with heart rate than does the C9-graded scale except at a work load level of 1200 kpm x min^{-1}, the differences not being statistically significant. Correlations with the RPE-scale are also higher for the Sn10-gr scale compared to the C9-gr scale. The differences are statistically significant at work load levels 600 and 900 kpm x min^{-1} ($p \leq .05$).

In clinical work it has been suggested that a rating scale should have expressions such as "knappt kännbar" ("hardly noticeable") "tydlig men

svag" ("evident but weak") on low rating levels and on higher levels "nästan outhärdlig" ("nearly unbearable") and "outhärdlig" ("unbearable"). Those expressions as well as others used in the scale were tested in the same manner as the verbal expressions used in the semantically constructed scales had been investigated (see Borg & Lindblad, 1976). Subjects were asked to rate the expressions in terms of a certain degree of perceived exertion with the frame of reference - no exertion at all to maximal exertion. The results are shown in Table 8. The expression "tydlig men svag" ("evident but weak") seems to be a slightly stronger quantifier than "svag" ("weak") so it can not, as has been suggested, be placed before or besides the expression "svag" ("weak"). The expressions "nästan outhärdlig" ("nearly unbearable") and "outhärdlig" ("unbearable") have low deviations which is due to a typical roof effect. Of twenty subjects in group I, seven placed the expression "outhärdlig" ("unbearable") outside the range - none at all to maximal. The expression "knappt kännbar" ("hardly noticeable") proved to be of relatively good accuracy and can be used in a scale as a complement to "mycket, mycket svag" ("very, very weak"). It is here important to note that instructions given to patients or subjects play a major role. An instruction is proposed in the appendix.

Since several scales have been used during the past few years in clinical and experimental work it has been considered useful to translate the scale values of the C9-gr, S9-gr scales to the new Sn10-gr scale.

The Sn10-gr scale is chosen to be used from now on as a general scale for ratings of subjective symptoms since it gives a good correlation to RPE-ratings as well as heart rate. It is also non-symmetric which, as mentioned earlier, has proved most useful. The expression "knappt kännbar" ("hardly noticeable") has been added in order to clearify the meaning of "mycket, mycket svag" ("very, very weak").

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6

7 Mycket, mycket lätt

8

9 Mycket lätt

10

11 Ganska lätt

12

13 Något ansträngande

14

15 Ansträngande

16

17 Mycket ansträngande

18

19 Mycket, mycket ansträngande

20

0 Ingen alls

1 Mycket, mycket svag

2 Mycket svag

3 Ganska svag

4 Rätt så stark

5 Stark

6 Mycket stark

7 Mycket, mycket stark

8 Maximal

0 Ingen alls

1 Mycket mycket svag

2 Mycket svag

3 Rätt svag

4 Varken svag eller stark

5 Ganska stark

6 Mycket stark

7 Nästan maximal

8 Maximal

0 Ingen alls

1 Mycket, mycket svag

2 Mycket svag

3 Ganska svag

4 Varken stark eller svag

5 Ganska stark

6 Stark

7 Mycket stark

8 Mycket, mycket stark (nästan max)

9 Maximal

SN-10 GR SCALE

0 Ingen alls

1 Mycket, mycket svag (knappt kännbar)

2 Mycket svag

3 Ganska svag

4 Varken stark eller svag

5 Ganska stark

6 Stark

7 Mycket stark

8 Mycket, mycket stark (nästan max)

9 Maximal

I N S T R U C T I O N

Instruction to give to the patient, meanwhile let him/her look at the rating scale:

"With the help of this rating scale you are supposed to tell me how you feel, how you perceive the symptoms I will ask you about.(The test leader specifies the symptoms.)

I will not ask you to specify the feeling but to select a number which most accurately corresponds to your perception of the symptom like .....
If you don´t feel anything, e.g. have no exertion or pain, you will answer with 0 - *Nothing at all* - if you start feeling something, just about noticable you answer with the number 1 - *Very, very weak, hardly noticeable* -.
If you have a very strong feeling of e.g. pain you might choose the number 7 - *Very, very strong* -. The maximal rating scale point can be the absolute strongest feeling, which you have ever experienced. The more you feel, the stronger the feeling, the higher the number will be which you choose. Keep in mind that there are no right or wrong numbers, try to be as honest as possible and do not overestimate or underestimate your ratings. Do not think of any other sensation than the one I ask you about. Do you have any questions?"

If the scale is used in a clinical work test let the patient get well aquainted with the rating scale before the test. During the test let the patient do the ratings at the end of every working period, that is about 30 seconds before changing the work load.
If the test is interrupted before the working period is ended let the patient rate the feeling when he/she stops.

Abstract card

Borg, G., and Lindblad, I. A comparison between different category scales for evaluation of subjective symptoms. Reports from the Institute of Applied Psychology, the University of Stockholm, 1979, No. . -
The aim of this investigation was to compare different category scales and to construct one scale to be used generally for ratings of subjective symptoms as a complement to the RPE-scale (i.e. the commonly used scale for Ratings of Perceived Exertion). The symptom studied with all scales was the exertion during work on a bicyle ergometer. 117 subjects participated, divided into four groups. Scales used were: The RPE-scale, two nine-graded category scales which differed in verbal expressions used as anchors at scale points, two ten graded category scales, also differing in expressions used at scale points. The scales were compared as to their linearity with heart rate and as to the correspondence with heart rate and the RPE-scale. It was found that rating behavior was slightly influenced by the choice of verbal expressions placed at scale points. Very high correlations were found between ratings and heart rate for all scales used. It is proposed that one of the ten graded scales should be used as the best complement to the RPE-scale.

Reference card

Borg, G., and Lindblad, I. A comparison between different category scales for evaluation of subjective symptoms. Reports from the Institute of Applied Psychology, the University of Stockholm, 1979, No. .

Brandpost
får ej blockeras
Paloposti
ei saa tukkia
Πυροσβεστικὸς κρουνός
μὴν κλείνετε τὸ Χῶρο
HIDRANT
Ne sme se blokirati

SKYDDSOMBUD

HUVUDSKYDDSOMBUD

SKYDDSKOMMITTÉ

Var rädd om händerna!

SKYDDSHJÄLM
obligatorisk på denna arbetsplats

Skydda synen så att du kan njuta

Nödutgång
får ej blockeras
Varauloskäynti
ei saa tukkia
Εξοδος κινδύνου

Arbets-miljölagen

Rökning förbjuden
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Cover

The views and wishes of 2,000 forestry workers may encourage manufacturers to make lighter and more comfortable protective clothing for forestry work. Page 46. Cover photo: Leif Öster, State Forest Service.

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Employees took an active part in planning the working environment of the Braviken paper mill on the Baltic Sea. Article page 10.

Here we go again!

☐ There is a regular program on Swedish TV called "Foreign Report," which provides viewers with detailed information on a certain country. It may deal with a specific event, a political situation, or new discoveries, methods, etc. It is always interesting, and sometimes very exciting.

Thanks to TV, we have in our time a better potential for learning about and understanding other countries and their special living conditions. As a result of these new possibilities, you might expect that the nations of the world would learn to more effectively cooperate in respect of the bigger problems that now confront us: employment and the environment, for example.

But when dealing with these large and urgent questions, which concern all nations and all peoples, it seems as if informational efforts are a waste of time.

Language is not an insurmountable problem because we have other channels of expression. For many decades, international organizations such as ILO have strived to create a better environment for people the world over. A large number of ILO's initiatives have resulted in improved working conditions, but much remains to be done.

One of the oldest organizations in Sweden, which from the beginning has aimed to improve the working environment, is the Swedish Work Environment Association, established in 1905, which will next year celebrate its 75th anniversary.

Since 1913 one of the Association's most important functions has been to publish a magazine which, until 1970, was called *Arbetarskyddet* (Worker Protection) and is now called *Arbetsmiljö* (Working Environment). At the moment, it is published 15 times a year and has a press-run of 145,000. The majority of copies go to safety stewards. Today, there are 118,000 registered safety stewards in Sweden. They are elected by their union members and their activities are based on the working environment legislation.

Since 1977 *Arbetsmiljö* has published an international edition in English once a year. As far as distribution is concerned, we have been helped by the Swedish authorities which deal with foreign contacts and international organizations such as ILO.

The objective of the international edition is, of course, to inform foreign readers of working environment developments in Sweden, but also to create better contact between people and organizations involved in working environment matters.

To date, we are satisfied with the result. We have received hundreds of letters, and the thousands of requests for extra copies of the 1978 international edition are proof that it is appreciated in different parts of the world.

You are invited to write to us and provide the address of someone in your area who would be interested in receiving information occupational health services and working environment training in Sweden.

If our international edition can contribute to an improved exchange of experience between countries, we will have fulfilled an urgent need.

In turn, we are also interested in receiving tips and advice from readers of *Working Environment 1979*. We can then present this material to our Swedish readers.

Many attempts are now being made to collect information from the member-nations of ILO and communicate it to those who request it. The CIS abstracts, for example. This is very promising and should be strongly supported. It is not enough to merely *carry out* research. Whether or not research is relevant from a working environment viewpoint depends on spreading information.

Of what use is research if the result is not put to practical use? And if we do not communicate the success or otherwise of our endeavors? Next year there will be a new world congress for working environment questions – this time in Amsterdam, Holland. Hopefully, most nations will be represented in order to report on the latest developments.

We all need a "Foreign Report."

Bertil Delin

Epoxy is used for coating floors. This job is often messy and the epoxy penetrates the workers' clothes.

Skin Allergies

–the most common of all occupational diseases

□ Nearly half of all registered occupational diseases are skin diseases. In Sweden there are seven occupational dermatology clinics, which specialize in skin diseases caused by substances in the working environment. Occupational dermatology includes dermatology, environmental chemistry and social medicine. One of the clinics is found at Lund University Hospital in southern Sweden.

Dr Sigfrid Fregert came to the Department of Occupational Dermatology at Lund in 1957 to work as a consultant for six hours a week. Today he is Chief Physician at the clinic and together with thirteen fellow employees works to solve problems of occupational dermatology. The work force consists of four physicians, three occupational hygienists, laboratory assistants, a medical welfare officer and secretaries.

The catchment area of the clinic covers just over 10,000 work sites. Half of the operations at the clinic consist of preventive work. The other half is medical care. To become a patient at the Department of Occupational Dermatology, a person must have a referral. These referrals come from the outpatient dermatology clinic at Lund University Hospital, as well as from industrial physicians, other doctors, safety engineers, trade union safety delegates and company managers.

People wait before going to the doctor

"At the end of the 60's an international investigation was made, covering about 4,000 Europeans with the skin disease contact eczema," says Sigfrid Fregert. "It turned out that around half of them had had their disease for at least a year before they contacted a doctor.

"Here we try to have a short waiting time of two to three weeks. The sooner you treat a case of eczema, the faster it heals."

The clinic finds a connection between a skin disease and an occupation in about half our patients. One-fourth turn out to have a skin disease not caused by their occupation but which creates problems for them at work. For this reason it too becomes a problem of occupational dermatology. The last fourth have a common skin disease that doesn't prevent the patient from working as usual.

There are two types of contact eczema, allergic and irritant, which are about equally common. To determine whether there is a contact allergy in a patient, so-called patch tests are carried out.

Patch tests with 25 different substances

"The so-called standard patch test includes 25 different substances. Altogether they cause around 75 % of all allergic contact eczemas."

Patches containing the various substances are attached to the patient's back for 48 hours.

"The difficult thing for us is doing tests with the substances that cause the remaining 25 % of allergic eczemas. There it's a matter of finding one of thousands of substances in the environment which may have caused an allergy."

"We perform tests with everything from plants and textiles to electric cir-

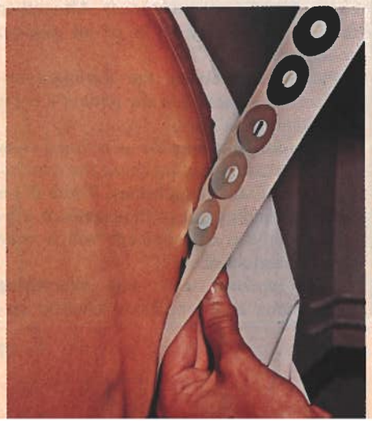
Substances that cause contact eczemas are displayed on the "wailing wall" of the dermatology clinic at Lund.

cuits," lab assistants Kerstin Hjorth and Anita Hänninen explain.

Occupational eczemas have social and economic consequences

Occupationally-related skin diseases and those dermatoses which create difficulties in working often have social and economic consequences. This is particularly true if a change of job is to take place, with or without re-training for other work. For this reason there is a social welfare officer at the clinic who helps patients with their problems. Attention is also devoted to their eligibility for social insurance benefits. In addition, the welfare officer follows up how things go later on for patients.

You can be allergic to watch strap calendars like these. The Lund dermatology clinic has found unhardened epoxy on them.



Visits to workplaces provide important knowledge

"Every year we visit 25 to 50 plants. This is like a drop in the ocean. But it's still important. We have to learn how things look at workplaces to be able to ask our patients the right questions.

"Our collaboration with Swedish industry works well. We've always received the information we've needed. The information we get is often confidential, but this doesn't entail any risks to industry since we work under professional secrecy."

"We can only provide information and advice but not publish regulations. We have discussions with companies and their safety committees and with trade unions and suppliers on how to solve these problems."

In the long term, occupational eczemas can be prevented by chemically changing allergenic products. One way is to replace a substance with another. Another is to alter the substance chemically. The clinic is following the latter principle in its attempts to develop an epoxy system which does not trigger allergies.

Epoxy products consist mainly of a hardening agent and a resin. Because of their good technical properties, epoxy products are widely used, for instance, in the construction and engineering industries and within electrotechnology. What is hazardous is the unhardened epoxy resin. It is used to glue metals, ceramics, to coat floors and for many other things.

"Industry has been using epoxy for 30 years. Four years ago we began our epoxy project. We've found that the resin whose molecular weight is 340 is the one that causes allergy."

Better to alter than prohibit

"But we can't say 'Forbid epoxy'. So we want to alter epoxy chemically in such a way that it doesn't trigger allergies but is technically usable."

"At our suggestion the clinic has received nine different 'modified' epoxy resins from two big multinationals. We're now testing these nine modifications to see if any of them might result in a harmless epoxy."

The clinic uses hundreds of guinea pigs in its tests each year. Among the reasons for using guinea pigs in particular is the fact that their skin reactions are similar to those of human beings.

The GPM (Guinea Pig Maximization) test is used at Lund. The way this works is that the substance in question is both injected in the animal's skin and placed on the skin. After three weeks an ordinary patch test is carried out. About 40 animals are needed for one round of tests, and this makes it quite expensive.

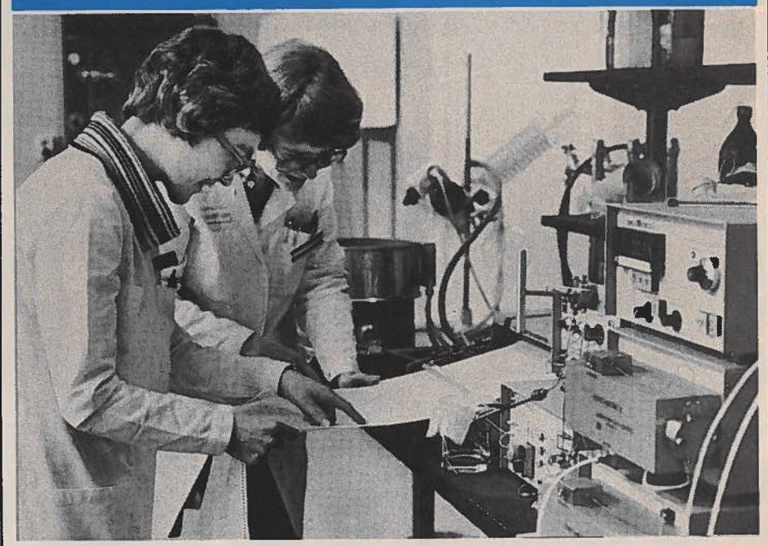
Another project at the Department of Occupational Dermatology has been to develop a cement which does not involve any hazard of chromate allergies. Chromate eczemas usually last throughout a person's life.

Occupational hygienist Birgitta Gruvberger explains that she has been working with the cement/chromate problem for several years. The solution was to add iron sulfate to the cement. The iron sulfate reduces the chromates in the wet cement to chrome compounds that are difficult to dissolve.

How does the clinic provide information on its research findings?

"We present papers and give lectures, provide information through newspapers and magazines, write books and hand out loads of information material."

Inger Ekman



Occupational hygienists Birgitta Gruvberger and Karin Persson looking for the molecule 340, which is found in unhardened epoxy.

Photo: Ragnar Mårtensson.

Sigfrid Fregert:

"We need a state-run institute to allergy-test products"

□ Providing information is part of preventive work. People also need to receive data on what products contain allergenic substances.

According to the Act on Products Hazardous to Health and the Environment, harmful products should be labeled as hazardous. Chemical products with a low content of such substances as formaldehyde do not need to be labeled in this way. Such products should also be required to be labeled as hazardous. Importers and manufacturers are the ones chiefly responsible for making sure labeling takes place.

If a company wants to allergy-test a product, this cannot be done in Sweden. The product has to be sent to foreign laboratories in Britain and Holland.

There are no plans for a state-run institute in Sweden. But this is one of Sigfrid Fregert's wishes for the future.

"As things are now, companies receive reports from the foreign laboratories on the products tested. Among these reports we have found some that were incorrect. This is why we are now sending out a report entitled 'Testing of Properties of Chemicals in Triggering Skin Allergies' to companies. There they can read for themselves about common errors and misinterpretations in the foreign reports."

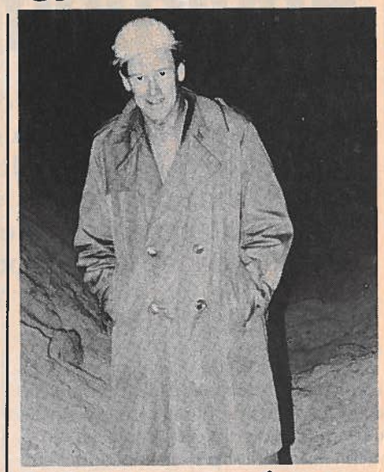
Training is lacking

There is no tailor-made training in occupational dermatology in Sweden. For some years, the Department of Occupational Dermatology at Lund has provided a number of dermatologists with certain training.

Despite the fact that much still needs to be done to develop occupational dermatology programs in Sweden, the country is quite advanced in this field compared with the rest of the world.

"There are only a few departments of occupational dermatology in Europe."

The Lund clinic has a lot of international collaboration. A couple of times a year, an International Contact Dermatitis Research Group has meetings. The group is now also publishing a journal entitled Contact Dermatitis through Munksgaard in Copenhagen. Its aim is to provide current information to colleagues throughout the world. And if the members of the group encounter a tricky problem, they send a letter to the other members asking their advice. ■



Dr. Fregert inspecting a factory.

How Employees Helped Plan the Environment at the Braviken Paper Mill

In the autumn of 1977, production began at the Braviken paper mill outside Norrköping, an industrial city on Sweden's Baltic coast south of Stockholm. During the two years it took to build the factory, the employees took an active part in planning its working environment. But the task of improving the working environment is not over. It still continues.

□ Braviken belongs to Holmens Bruk, a company which is Europe's biggest producer of newsprint. At Braviken, both thermomechanical pulp and newsprint are made.

There are 360 employees at Braviken. Most—280—belong to the Swedish Pulp and Paper Workers' Union. The remaining members of the work force belong to the Swedish Foremen's and Supervisors' Association (SALF) or the Swedish Union of Clerical and Technical Employees in Industry (SIF).

Many of those now working at Braviken were previously employed at one of Holmen's other factories, for example the now-closed sulfite pulp mill at Loddby or the paper mill located in central Norrköping.

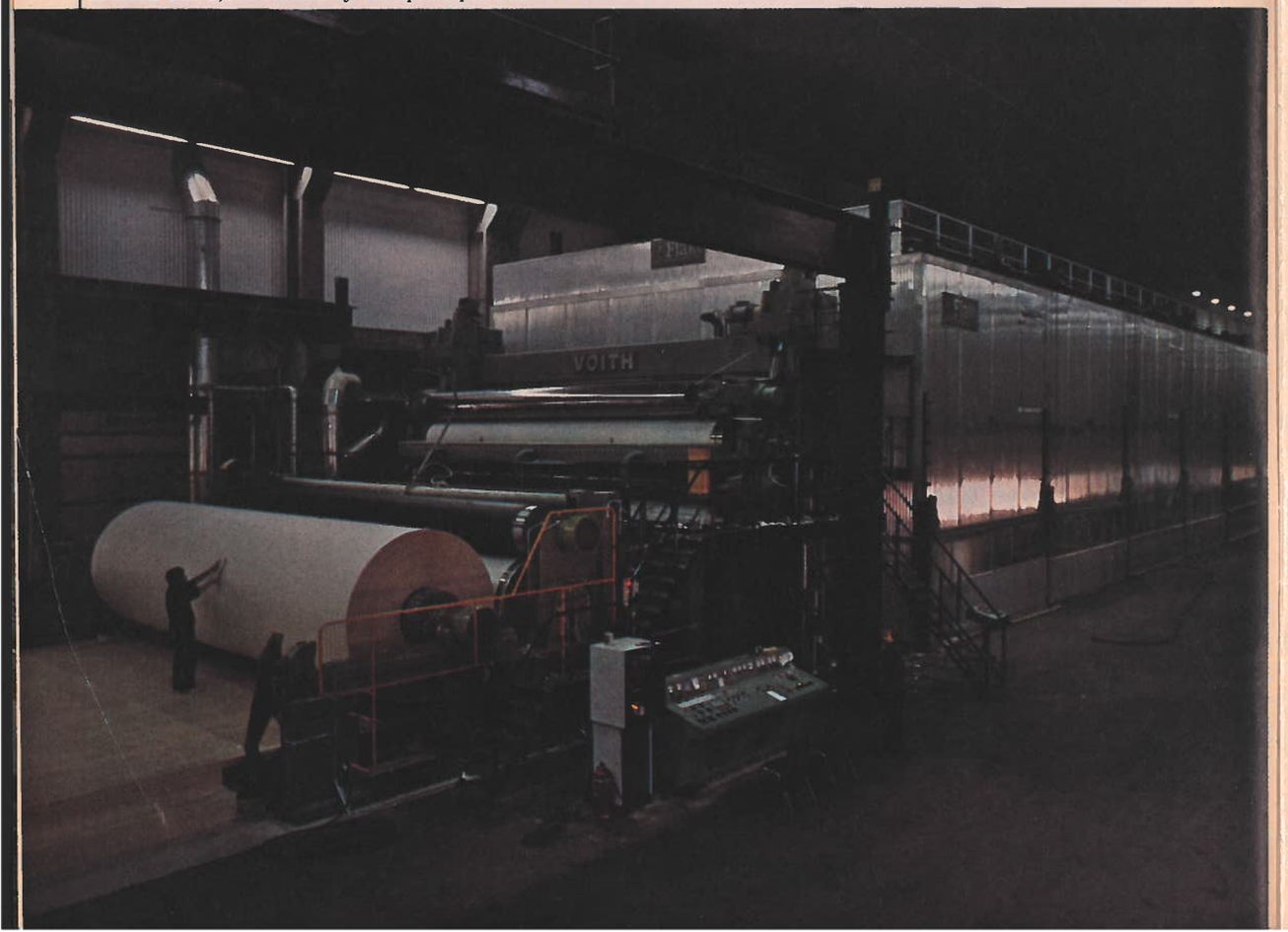
During 1975—1977, while Braviken was under construction, the employees took an active part in planning their future working environment.

This is how it worked:

The organizational plan consisted of eleven sub-projects, where there was discussion of matters including wood-handling, mechanical pulp, the paper mill, the steam generating plant, power distribution, connections with the factory area, the machine shop, external environment, personnel, and adjustments of older departments.

Specialist technicians from Braviken each kept track of their own fields. From the start, there were joint labor-management consultations on planning of the various sub-projects. In these consultations, employee representatives kept track of the design of workplaces. The Labor Inspectorate district office in Linköping also took part in these discussions.

Braviken's huge PM 51, one of the world's fastest paper-making machines. It turns out 1,100 meters of newsprint per minute. Photo: L. Alderin.



Asked the membership

Yngve Pettersson and Ingemar Andersson were involved in the joint consultation groups and are two of the chief safety stewards for the Pulp and Paper Workers' Union members.

They explain things like this:

"We began by going out and asking all our members how they wanted the working environment to be at Braviken. In this way we got a lot of wishes that we were able to bring up in the joint consultation groups.

"Then we gave information at the meetings of the union local on what had happened in the joint consultation groups and our members were able to present their views." Ingemar Andersson feels that at times it could be hard to get the message from the joint consultation groups to the engineers who designed machines. These design engineers were sitting in different parts of the country and the world. In some cases their construction blueprints had to go back and forth several times before everyone was happy.

"Most of the demands we made in the consultation groups were followed," says Ingemar Andersson.

The working environment at Braviken also turned out to be spacious, with walkways that provide easy access and walls and ceilings frequently covered with sound-absorbent materials. Where possible, machinery and engines have been sound-proofed.

Automated production

The manufacturing of thermomechanical pulp is entirely automated. Employees supervise and control production from control rooms via electronic equipment, computers and video display screens.

The paper machine and rolling machines are also operated from control rooms. But of course there are also people who work outside the control rooms, maintenance staff for example. Not all employee wishes were carried out at Braviken. The company management felt, for instance, that it was the task of the public sector and not the company to build jogging paths and a boat harbor.

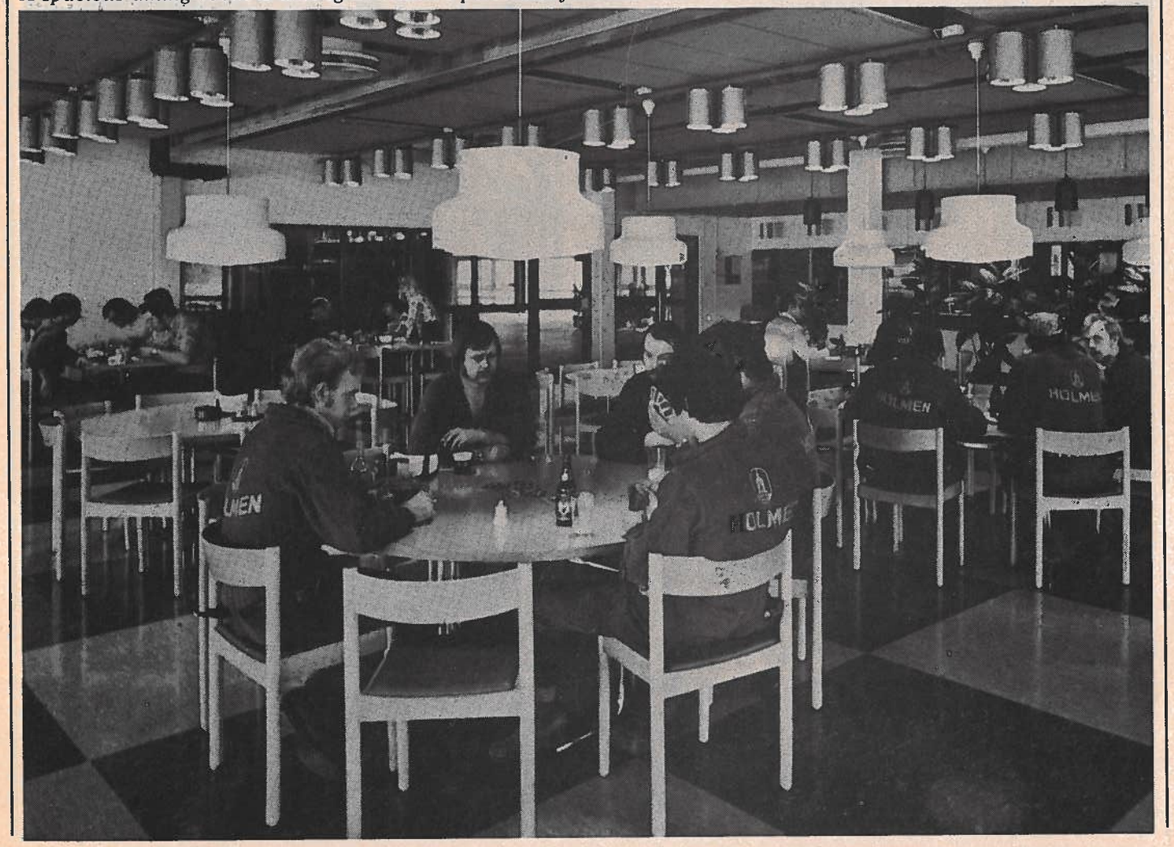
The discussions in the joint consultation groups often returned to the question of how heavy lifting ought to be handled, especially by maintenance staff. The principle was that there should be such large spaces that a fork-lift truck could easily be brought in along walkways and lifting beams and lifting eyes be employed from the ceiling. In some places, however, there can still be too little space. This is because after the first round of planning, various equipment was added and had to be placed somewhere. But employees should not normally have to lift more than 25 kg.

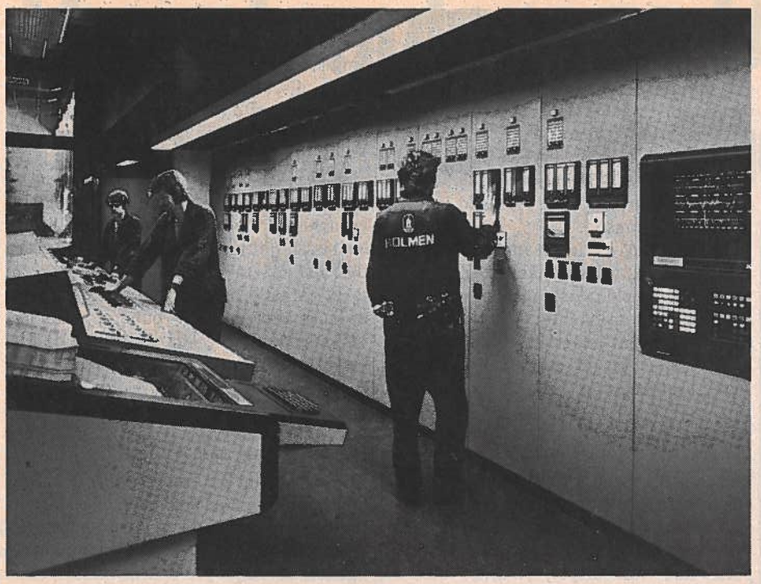
Locker rooms and lounges

The design of personnel areas was another question that was much discussed in the joint consultation groups, and an architect was allowed to carry out an investigation of employee wishes. The result was 44 separate locker rooms, each with 5—15 lockers.

"It's a sheer dream when you compare it with the paper mill in Norrköping, wherer 160 people changed clothers in a badly-ventilated basement area," says Ingemar Andersson.

A spacious dining room is among Braviken's personnel facilities.





The PM 51 is operated from a separate sound-proofed control room.

The only control panel at the PM 51 itself (see also page 10) is used for set changes.

The consultation groups also believed it important that those who take advantage of the lounges (located directly adjacent to the control rooms) during their breaks really have a chance to interrupt their working routine. These lounges contain such things as a refrigerator, a hot plate, microwave ovens, a coffee machine and heating cabinets.

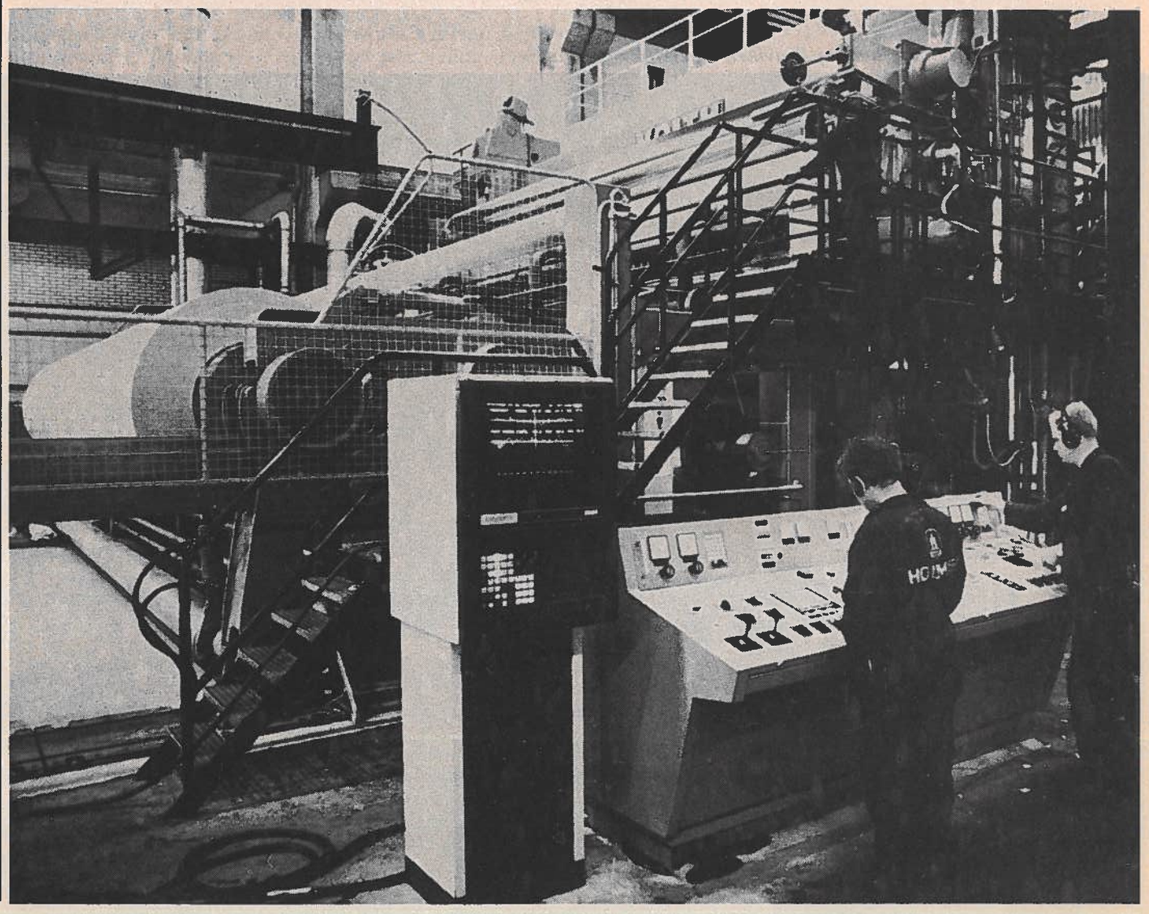
Employees on shift work and daytime staff working overtime are able to buy deep-frozen food from a machine at sharply reduced prices. This is intended to encourage them to eat food instead of just drinking coffee.

Those who are working during the day can otherwise eat in the bright, spacious dining room, where there is also space to eat outdoors.

Never satisfied

There is still work to do in order to improve the working environment. Or as Yngve Pettersson puts it:

"We're never satisfied. For example, we have certain problems with ash disposal at the steam generating plant. There simply isn't any good technical solution for handling the ashes. But there's a development project going on now at Braviken to try to work out the problem."



Nor has technology managed to bring down the noise level everywhere. As an example we might mention the wood room, where the barking drum has not been enclosed because this would make it hard to supervise operations. People working in this area have to wear hearing protectors. This applies, for example, to the operators going on their rounds to check operations and in some cases also maintenance staff.

Noise annoys

Pelle Becker, who represents the foremen, feels that the high temperature as well as the noise level from the pumps in the pulp factory can be annoying to maintenance employees, who obviously cannot work from the control rooms.

It is hard to find a solution to this, since it would have been very troublesome to handle maintenance if the pumps had been enclosed. But it has proved possible to lower the noise level in the area by placing sound-absorbers on walls and ceilings.

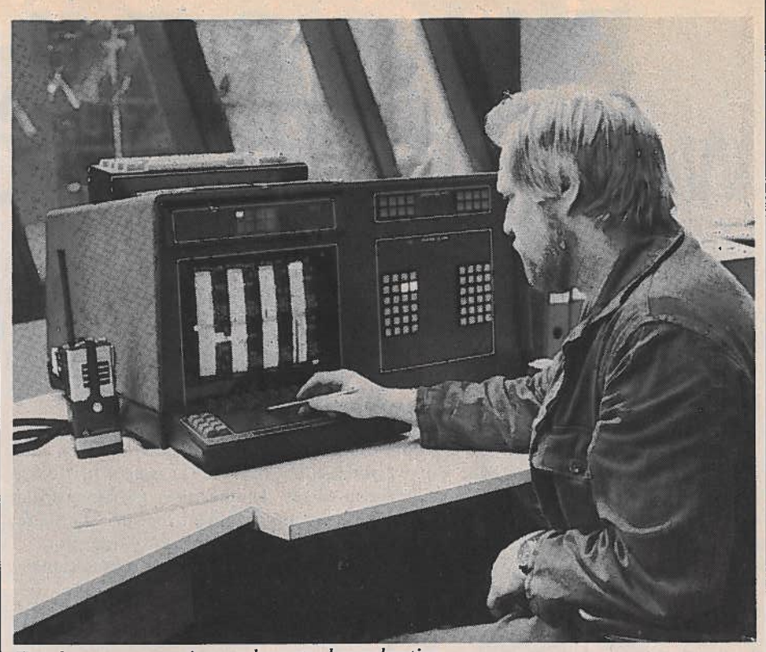
Ingemar Andersson tells about another problem: "In the final stage of construction they saved a million kronor by moving the fork-lift truck shop into the maintenance people's shop. It turned out, however, that when the fork-lifts were being washed, gases from the very strong detergents poured into the workshop."

To remove this unpleasant situation, the washing area is being enclosed. There are also plans to move the fork-lift shop when a new paper machine is installed. But the year of construction has not yet been decided.

Low level

The working environment at a new factory does not become ideal all at once. Safety stewards and safety engineers are continuing to work for a better working environment at Braviken.

"If problems arise in the working environment, the principle is that we try to solve them at as low a level as possible," says Ingemar Andersson. "The guys tell their foreman or their safety stewards about things that are wrong or missing."



Employees supervise and control production via electronic equipment.

"If it can't be solved at once, we bring up the matter at a section meeting, which is held once a month. Those taking part are the safety stewards, safety assistants and the respective section head."

"Then the matter might go further to the working environment committee, which holds a meeting every second month. The committee includes the head of maintenance, the safety stewards, safety engineer, company doctor and company nurse."

"Major issues are brought up in the safety committee, which meets once each quarter. If it's an urgent matter, of course the meeting can be held earlier. The meetings of the safety committee are held jointly with about 15 representatives of management and employees at the Braviken and Norrköping plants. The trade union representatives have a one-vote majority. In other words if they're unanimous they can put a decision through."

"Finally, we can also bring in the Labor Inspectorate. But no issue has ever gone that far. So far we've always been able to reach agreement."

Older employees remain

When Braviken was built, members of the various project groups made an effort to create such a good working environment that people would be attracted there and enjoy working there. Those who have been attracted to Braviken from the paper mill in central Norrköping are mainly young people. Even though the mill in Norrköping is old and has a worse working environment, most older employees chose to stay there.

"It can be hard to move from a workplace you've become accustomed to when you may not have so many years left until retirement," Ingemar Andersson explains.

Benedicte Helmersson

The Braviken pulp mill has the capacity to produce 280,000 metric tons of thermomechanical pulp per year. This pulp is used both in the manufacture of newsprint at Braviken and in the manufacture of magazine paper at the old mill in Norrköping.

The paper machine in Braviken, PM 51, is 100 meters long. It has a track 8.5 meters wide and can produce 1,000–1,200 meters of paper per minute, or 500 metric tons of paper in 24 hours. The paper machine is operated by five people per shift.

Safety organization at the workplace

Safety stewards are elected–by the union organization–at every workplace with five employees or more.

The job of the safety steward is to supervise the work environment and represent the employees in matters of health and safety.

Larger workplaces have several safety stewards, one of whom is elected chief safety steward.

Companies with 50 employees or more are required to have safety committees, where management and labor cooperate. The unions have one representative more than the employer on these committees.

The safety committee plans and supervises occupational safety and health activities and is responsible for the technical and medical occupational health service of the company.

Erixon & Eriksson
Working Environment Consultants

Frank Erixon represents the workers, Hans Eriksson the employers. But they are close collaborators in working environment questions and a common sight for members of the Swedish Pulp and Paper Workers' Union as they travel around the country lecturing and demonstrating at pulp and paper mills.

By Anders Elghorn

□ The working environment of old pulp and paper mills is rather poor. The worst problems are disappearing as the mills are gradually modernized, but a great deal remains to be done before working environment experts can relax.

No one knows this better than Frank Erixon from the Swedish Pulp and Paper Workers' Union and Hans Eriksson from the Swedish Forest Industry Association, an employers' organization. Still, it is no exaggeration to say that without them the working environment of the Swedish pulp and paper industry would be substantially worse than it actually is.

Fifteen years ago the concept of the working environment did not have the impact that it does in modern-day Sweden. There were, of course, complaints about workplaces, but the assumption was always that people should adapt to work, not vice-versa. There was low consciousness concerning safety activities.

Gradually, a new approach developed, based on the idea that many accidents can be avoided if people are made aware of the problems. In other words, train people in work safety.

But not engineers and staff people – no, the experts, it suddenly dawned on people, already existed on the workshop floor beside their machines.

Frank Erixon and Hans Eriksson met for the first time 12 years ago. It is difficult to say whether they got along from the very first moment, because they are two quite different personalities. But, in any event, they took their jobs seriously and tentatively began to build up an organization for training workers (and even white-coller staff people) in working environment questions.

Their methods were somewhat unconventional. For example, during training courses they played their roles as employee/employer and treated students to theatrical presentations of real-life situations. Often, their confrontations were rather dramatic, especially when they were attacking each other's position.

At that time, this was perhaps necessary in order to hold students' attention hour after hour. Most of the material presented was new, as legislation and reforms went through at a fast pace.

During the years, Erixon and Eriksson have acquired a substantial knowledge of working environment matters. Today, they are without doubt among Sweden's leading authorities in this field. They have always ensured that the Pulp and Paper Workers' Union is well advanced as regards all forms of training for the working environment.

While the Swedish Confederation of Trade Unions haggles about new legislation and its introduction, Erixon and Eriksson get on with the job of training students in the practical details.

Whatever you may think about cooperation between employers and employees – and Erixon and Eriksson have been criticized in this respect – in this case it seems to have worked.

Erixon and Eriksson, working environment consultants. Throughout the year they travel all over Sweden spreading their message. Moreover, there is no resistance from companies. On the contrary, they are much in demand.

And everybody listens. Safety stewards, safety engineers, company doctors and directors attend joint conferences. No audience feels out of place for Erixon and Eriksson. Their message carries authority.

If you call the Paper and Pulp Workers' Union and ask for Frank Erixon, he is most often away traveling. At the Forest Industry Association, it's the same story with Hans Eriksson. They are usually visiting the same mill.

The price of all this is a curtailment of family life, which is normal for those active in trade union work. That part of the working environment is, of course, not covered by legislation. ■

Where there's Eriksson (left) there's also Erixon – and a pulp and paper mill.

Photo Orjan Dahlberg

Clinics for Occupational Medicine —An Important Part of Swedish Work Safety

There are currently seven of them in Sweden. The most distinguished one is the Clinic for Occupational Medicine at Örebro, headed by Chief Physician Lennart Sundell, whose deputy is Christer Hogstedt. In this article, Dr Sundell and Dr Hogstedt answer some questions about the activities of the clinic.

□ What does an occupational medicine clinic do?

"The Clinic for Occupational Medicine in Örebro is a consultative agency for problems of industrial medicine," says Dr Lennart Sundell, head of the clinic. "We investigate and evaluate both workplaces and patients within four county council areas with half a million employees."

There are occupational medicine clinics at five of Sweden's seven regional hospitals and plans for expansion both to the remaining two regional hospitals and eventually also for creation of small units for occupational medicine at more than 20 county hospitals. The Örebro clinic began in 1966 and its operations follow the guidelines which a Government-appointed study commission had recommended a few years earlier (see Facts Box). The clinic is the regional occupational health specialist for four county councils, which share its operating expenses. The clinic has a total of 21 full-time positions and costs just over three million kronor a year.

All physicians within the entire region may refer patients for evaluation of any connections between an illness and the patient's working environment. These investigations are carried out on a hospital outpatient clinic basis and there are no inpatient beds at the Clinic for Occupational Medicine. Three doctors with specialist qualifications work at the clinic, assisted by three staff physicians. At the clinic there is also a laboratory, with five employees, which analyzes samples of dust and gases from the air but also environmental poisons in the blood and urine of employees, for instance lead and cadmium in the blood. The samples come from the clinic's own four industrial hygienists as well as from occupational health services within the region which pay for these analyses.

Epidemiological studies

"The aim of industrial medicine programs should be to prevent and discover occupational diseases, and this requires scientific activities," says Christer Hogstedt. "About half the clinic's time is devoted to the discovery of new hazards, improved methods of measurement and other development work."

The Örebro clinic is best known for its research in occupational epidemiology, i.e. its studies of the incidence of diseases among categories of employees. Studies that have received international attention have concerned lung cancer among miners and tumor death rates among workers exposed to pesticides, arsenic, trichlorethylene and ethylene oxide. Other studies have concerned nerve and brain damage with mental symptoms among painters and others working with solvents. The clinic will shortly publish a dissertation on medical hazards affecting dynamite workers, who have been shown to have an excessive mortality rate from cardiovascular ailments. Many studies are carried out together with the Clinic for Occupational Medicine at Linköping and Professor Olav Axelson, who initiated this epidemiological work during his years at Örebro.

Shouldn't such a strongly research-oriented program be carried out at universities or research institutions?

Christer Hogstedt:

"We are limited in our opportunities to select projects, but our strength is in our close contact with workplaces and the occupational safety system. We can steer problems to the theoretical institutions and do collaborative projects, and we pass on findings from such institutions to workplaces."

Providing information on known hazards

"We also have large-scale informational activities," Lennart Sundell states. "Many of the hazards that employees are exposed to have been well-known for many years in the international literature but have not reached those people who are affected. For this reason we provide thorough information on both our own studies and those of others, we publish printed information and organize working environment training and conferences."

Psycho-social hazards are occupational medicine, too

The Örebro occupational medicine clinic was the first one in the country to obtain a permanent position for a psychologist. Besides its technical and medical departments it thus also has a department for behavioral sciences which works with behavioral toxicology, psycho-social problems and the development of methods for analyzing accidents. This implies a new addition to the traditional branches of occupational medicine, and opinion has been divided as to whether this work falls within the bailiwick of occupational health, but in Örebro they are convinced that it is a sound investment.

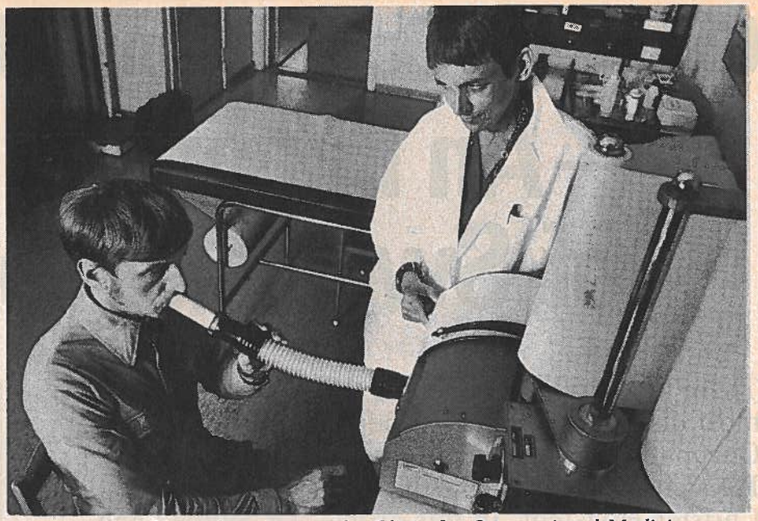
"We try to be a consultative agency for evaluating the impact of the working environment, and so it is natural for us to take advantage of our network of contacts to offer services in these fields as well", says Lennart Sundell.

Occupational health services and occupational medicine

In international terms, Swedish occupational health services are fairly large in scale. At present an estimated one-third of all employees in Sweden have access to some form of company-sponsored health service, which is supposed to devote half its time to preventive measures and the rest to patients with occupationally-related ailments and rehabilitation.

In Örebro County, these occupational health programs are more widespread than average, and about 60 % of all employees are within the purview of built-in occupational health services at large companies, occupational health care centers for a number of companies, or health services specializing in employees of a particular industry. Companies are not compelled by any legislation to offer occupational health services, but the Swedish Employers' Confederation (SAF) has signed agreements with the nationwide trade union confederations representing both blue-collar and white-collar employees, calling for total coverage by such services. Those who do not have access to occupational health care are mainly employees of small companies.

Dr Lennart Sundell was himself an industrial physician at Volvo for four years and has tried to create a close collaboration with both the medical and technical branches of the industrial health services in the region.



Examination of lung functions at the Clinic for Occupational Medicine at Örebro. Photo: Thomas Bergman.

Who makes the decisions on working environment?

Every employee in the region has the opportunity to contact the Clinic for Occupational Medicine at Örebro. Employee problems are often referred to the clinic by companies or trade unions acting as intermediaries.

Practically all medical care in Sweden is provided by the county councils, which also operate the occupational medicine clinics. What does this mean in relation to employers and unions?

Lennart Sundell:

"We try to base our evaluations on the best possible scientific background information. Our task is to point out and provide information on working environment hazards in order to avoid ill health among employees. We are not a regulatory or judicial body, but a consultative agency. Decisions on action programs and priorities are made by the safety committees within the occupational safety structures of companies, where both labor and management are represented. The Swedish trade union movement is active in the occupational safety field and pursues its demands independently. The employer side has access to the same data. The task of supervising compliance with the Working Environment Act is ultimately that of the Labor Inspectorate, whose districts are part of the national government."

Occupational medicine looking ahead toward the 80's

The expansion of clinics for occupational medicine in Sweden has occurred rather slowly. The first clinics began shortly after 1945. During the 1970's interest in working environment has rapidly increased, but developments have been hampered by a shortage of trained specialists in occupational medicine and occupational hygiene. The interest now exists and posts are beginning to be established but it takes a long time to train personnel for the work of occupational medicine, which requires knowledge not included in traditional training programs for doctors and technicians (engineers).

At present there are only 20-odd specialists in occupational medicine in Sweden but roughly as many again are in training. A more permanent training system for industrial hygienists, who are chemists or civil engineers, is also being planned.

What will the Örebro occupational medicine clinic be concentrating on as we enter the 1980's?

"We'll continue to follow the guidelines we currently work under, but with an even stricter emphasis on research and development work", Lennart Sundell replies. "We are improving our computer programs for epidemiological evaluations, which are increasingly assuming a routine character, and other studies of occupational health where it is possible to piece together material from different workplaces within the region." ■

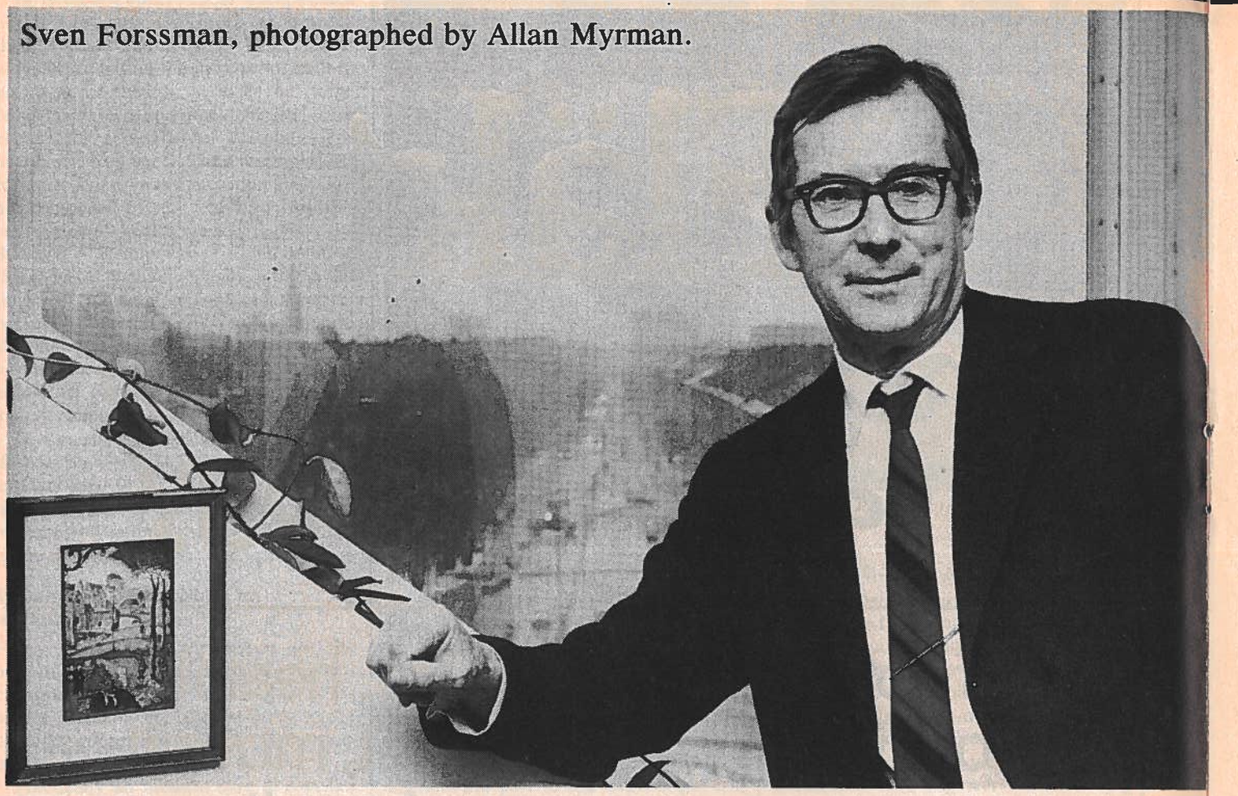
The Clinic for Occupational Medicine at the regional hospital in Örebro is a specialized regional agency serving Södermanland, Värmland, Västmanland and Örebro Counties in central Sweden. Its tasks are:

- to study how the working environment affects the mental and physical health of the individual
- to carry out investigations of employee categories exposed to the hazards of occupational diseases and of control groups, in order to discover deviations from a normal state of health
- to examine and treat patients with occupational diseases and carry out studies of those cases where occupational diseases are suspected to exist
- to make industrial hygiene and technical investigations at workplaces
- to analyze biological and technical test samples
- to carry out experimental investigations and research and development work in connection with the above
- to provide information and training.

The staff of the Örebro regional Clinic for Occupational Medicine consists of:

- 3 physicians with specialist qualifications (including the head of the clinic)
- 3 physicians undergoing specialist training
- 1 occupational health nurse
- 1 psychologist
- 4 industrial hygienists
- 2 laboratory engineers
- 3 laboratory assistants
- 4 secretaries
- 2 helpers

Research grants are being sought for major projects and at present one other psychologist, a safety engineer, two research assistants and a secretary are attached to projects at the clinic.



Sven Forssman, photographed by Allan Myrman.

The Workingman's Worker

What Sven Forssman is best at is hammering away at governments and industries to adopt safer and healthier practices for workers everywhere. Don Hinrichsen interviewed Sweden's internationally best known specialist in occupational medicine.

□ Every day there are thousands of carcinogenic time bombs ticking away in factories all over the world. One of the scientists who is trying to defuse these time bombs in the workplace is Professor Sven Forssman. In fact, he has spent the better part of four decades making the industrial environment a cleaner, safer and healthier place to work.

Forssman's decision to devote his career to occupational medicine wasn't a calculated step, but grew out of his unique educational background—a medical doctor with a BS in chemistry. Back in the 1930s, fresh out of the university, Forssman accepted the post of Associate Professor of Pharmacology, lectured on toxicology and then went into internal medicine. This, incidentally, was long before toxicology became a recognized science; it was also the infancy of industrial medicine.

Of course, Forssman was in an ideal place for his work. The Nordic countries, along with the Soviet Union and Italy, virtually pioneered the early advances in occupational medicine. Denmark began inspecting factories over 100 years ago. Norway was the first country to offer occupational health services to workers, and Sweden was first to research occupational health problems in a systematic way.

In 1938 Sweden established the National Institute of Public Health, one of the first in the world. Ironically, it was funded with Rockefeller Foundation money at a time when the labor unions in the US were still fighting for acceptance and to employers occupational health was like discussing the dark side of the moon.

Still, it was an uphill battle, even in worker-conscious Scandinavia. "Instituting research is one thing, getting the results implemented on the factory floor is another," cautions Forssman.

Despite the successes of the last decades, the need for even more worker-protection measures is obvious. Every year nearly 100,000 workers die as a result of occupational diseases or accidents, and tens of millions suffer injuries or develop work-related illnesses. Furthermor, on the average, five percent of *all* working days are lost because of occupational injuries. For example, in 1971, the Federal Republic of Germany reported 2.6 million. That same year, the US reported more than 5.6 million accidents recorded among 58 million workers. Even in Sweden there were nearly 125,000 occupational injuries in 1971 (out of 4 million people employed).

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Forssman's role in the struggle for healthy work environments really began in 1943 when he was appointed Professor of Occupational Health at the National Institute of Public Health in Stockholm. In 1951 he left to become medical advisor to the Swedish Employers' Confederation where he assisted in organizing a modern system of industrial health services. For 10 years he was chairman of the Joint (Employers' and Labor Unions') Industrial Safety Council. In 1966 he became the first general director and manager of the newly formed National Institute of Occupational Health, a position he held until 1972 when he moved to Copenhagen to work full-time for the World Health Organization's Regional Office for Europe as a consultant in occupational health.

Over the years, Forssman has watched his area of specialty mature. "In 1943 when I began working at the National Institute of Public Health we had a total of 5 people. By 1966 our small section became its own Institute and now there are thousands of specialists . . . industrial physicians as well as industrial hygiene and safety engineers . . . all working just on problems of occupational health and safety," observes Forssman.

"Today we know more and we demand more. Worker comfort and safety is recognized as an important aspect of employment, in fact it has become *very* important," stresses Forssman.

In many places, occupational health is beginning to command large sums of money as a priority area of research. And none too soon. For as some occupational diseases are rooted out and minimized, others keep getting uncovered, like a "can of worms." A classic example is the occupational disease known as *asbestosis*, a serious pulmonary disability that often struck down workers in asbestos plants. What was later discovered is that asbestosis was only a "cover-up" for the cancer that asbestos eventually causes. The workers who contracted asbestosis usually didn't survive long enough to die from the latent cancer that awaited them! That problem wasn't noticed until *after* the asbestos plants were "cleaned up."

Professor Forssman cites the worldwide proliferation of chemicals as one of the major occupational hazards facing us today, and not just workers—everybody. Out of 4 million chemical substances known, 60,000 are commercially produced and about 1000 new chemicals are brought into the market each year. Since the international trade in chemicals is increasing "chemicals must be combatted internationally," asserts Forssman.

"We started out by looking only at the acute effects of toxics, now we are frantically trying to nail down the long-term effects, that is, the effects of low level exposure over a long period of time. We also need to study the *combined effects* of toxic elements," he adds.

But that's only a beginning. "We must find ways of applying the research as soon as possible. Sometimes it doesn't get applied until years later. But application of the research is the key, we can't leave anything to God in this business," laughs Forssman.

As for the decisive question of "acceptable risks", Forssman thinks that occupational health specialists, as well as toxicologists and environmental scientists, should be discussing what constitutes an acceptable risk. "Zero is an acceptable risk, of course, but it is often not realizable. We will never be able to reach a no-effect level. So the question is: how much risk is acceptable? And this is ultimately a problem for the decision-makers."

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One way to minimize the risks is by implementing a well-planned and *integrated* occupational and public health care network. Forssman is a veritable "dervish" when it comes to this subject. Since he first began doing consulting work for WHO in the early 1950s, he has constantly stressed the need for a *comprehensive* approach to environmental health problems. "Piecemeal solutions are doomed in this field," he says. "Its like getting rid of a malaria by spraying chemicals on the mosquitoes, but how do you eliminate cholera which feeds on unsanitary conditions, unless you attack the basic problems."

Forssman has traveled extensively for WHO and has studied health problems in Asia, Africa and Eastern Europe. For 4 years (1973–1977) Forssman commuted between Copenhagen and Lodz, Poland where he was WHO's chief technical advisor for an international project to set up a model national institute for testing the toxicity of new chemical substances destined for use in industry. The project was jointly financed by the UN Development Program and the Polish Government, but much of the expertise was loaned from WHO who also was responsible for the administration of the project. "The Institute was officially turned over to the Polish Government in November 1977 and is now running very well," says Forssman. Recently, the Institute initiated the first course in the world which deals exclusively with industrial toxicology for developing countries.

Not surprisingly, this is another of Forssman's central interests.

Since planning health care, not to mention occupational medical facilities, is one of the biggest problems in developing countries, Forssman urges them to start small "pilot projects" connected to model regional institutes or centers. "Naturally, their problems are overwhelming, but you must start from the ground up."

Needless to say, much remains to be done in the developed countries, too. Having gotten off to a head start, Sweden is still ahead of the game a little. The idea of occupational health services is finally taking root in the industrialized countries.

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One of the reasons for this is that both the unions and the employers have confidence in the occupational health specialists, who, although they are employed by the company, are also members of the union. Therefore, Sweden (and also Norway) don't have the problems encountered in other countries where the company doctor is often suspected of being in the pocket of industry. "In Scandinavia, the occupational health specialists work with both sides," affirms Forssman.

At the moment, Sven Forssman is supervising a six-month graduate course on occupational health research methods in Copenhagen, tailored for a number of Danish physicians with two years or more experience. "The University of Copenhagen put up the money and WHO provided the staff. So far Denmark has very limited programs in occupational health *research*," he emphasizes, underlining the word research. "And, of course, they lack trained personnel."

Well, that's what Forsman is best at—pioneering, gearing up programs, building institutes and otherwise hammering away at governments and industries to adopt safer and healthier practices for workers everywhere. Sven Forssman, like the discipline he helped create, has come a long way. ■

SHAKY

"SHAKY" is the title of a project designed to help school personnel influence their own psycho-social working conditions. The word SHAKY is equivalent to the Swedish word "SKAKIS" which stands for "Samverkan kring arbetsmiljöns konsekvenser i skolan" (in English: Cooperation Concerning the Consequences of the Work Environment in School).

□ SHAKY originates from two sources. The first one is the new Swedish Working Environment Act in effect since July 1978, which includes the psycho-social conditions of the work environment and states that the working environment shall not only be designed to prevent health hazards but must be organized to ensure mental health and promote job satisfaction, the quality of life, etc.

The second source is a pilot study made in Nacka, a suburb of Stockholm. There a psychologist, Elisabeth Jonsson, worked with school personnel for three years starting in 1974. She saw them individually and in groups and she conducted organizational development studies. She evaluated her own work in a book: "Ett psykosocialt arbetssätt" (in English: A Way of Working with the Psycho–social Conditions of Work). It was the trade unions representing school personnel which took the initiative to demand the services of a consultant psychologist and Elisabeth Jonsson was employed by the Municipality of Nacka as the first psychologist in Sweden with this mission.

Let us take one example of how Elisabeth Jonsson met with the demands of the school personnel in Nacka from her own evaluation.

An organizational development study:

background — A teacher phones Elisabeth and tells her that she is dissatisfied with the role she plays in a department of a school; she is "the only one who takes responsibility", there are "no agreed-upon rules", "no order", "bad communication among personnel", "they do not know each other" etc. . . .

introduction — E sees all personnel in one group session; nobody talks; E asks them to answer the following questions in writing anonymously:
1. Do you enjoy working with youth?
2. Is there anything that you want to change about your working conditions?
3. Do you like this school? If not, why? What to do?

problem-solving — E relates the answers to her questions and the personnel decide they want to meet regularly with the following objectives:
– get to know each other
– get help to know oneself better
– discuss the role of the teacher
– work out rules for their working together

evaluation — After ten group sessions with E as leader the results were evaluated:
– the relations were now based on mutual trust and were more spontaneous
– better order and better cooperation

In 1978 Elisabeth Jonsson together with Roger Ellmin received funds from the National Board of Occupational Safety and Health for SHAKY. Elisabeth Jonsson is employed by the project as a tutor for other psychologists working in the same manner as she does and Roger Ellmin is engaged in evaluating the results.

The Clinic for Occupational Medicine, Regional Hospital, Örebro, has been engaged in informing industrial health centers for school personnel about the possibility of joining SHAKY if they employ a psychologist. Now there are two municipalities close to Örebro where a psychologist has been employed. Altogether SHAKY, which is planned for three years, consists of eight psychologists in eight municipalities in different regions of Sweden, both in rural and urban areas.

The eight psychologists are going to give the following service on three different levels:

Individuals	– psychotherapeutic contacts
Groups	– group therapy – communication and cooperation training in a group
Organization	– gather information about the psychosocial conditions of work in the schools to suggest alterations, – train headmasters and union officials to deal with problems of a psycho-social nature.

Each psychologist has a local advisory group consisting of representatives of the different unions that have members in the school and of one representative of the employer (the municipality). In this group the psychologist can discuss his/her work and get information about all kinds of services that might be asked of him/her.

Anders Agrell

Psychological Job Hazards—More Common Than You Think

Psychologically demanding jobs are as common as physically strenuous ones. Blue-collar workers in Sweden relate psychological strain chiefly to physical factors in the working environment. White-collar employees more frequently mention psycho-social reasons. But mental stress factors also contribute to their enjoyment of their jobs! Curt R Johansson, whose division at the Psychology Department of Lund University specializes in labor-related studies, summarizes a number of investigations on the psychological and physical hazards in Sweden's working environment.

□ It has only been during the past ten years that Swedish trade unions have investigated psychological stress in the working environment. To the extent that working environment issues were discussed at all during the early days of the trade union movement, it was often at the initiative of public authorities. Such discussions mainly concerned physical aspects of the working environment which could be regarded as posing obvious health and accident hazards.

As early as the 1930's, American researchers published findings which indicated that psycho-social conditions are important components in the working environment (Roethlisberger & Dixon,

1939). But it was not until the end of the 1960's that the Swedish trade unions began looking at these problems in a serious fashion. Many workers and white-collar employees felt at that time that important intangible values in the working environment were in the process of disappearing.

The new Working Environment Act that went into effect in Sweden in July 1978 clearly states that psychological and social needs related to work should be given attention. Employees should enjoy independence and responsibility on the job and be able to influence their own working situation.

This is of particular interest to white-collar employees. As a rule, their physical working environment has fulfilled the requirements of the old Workers' Protection Act. But the law did not mention the psychological working environment, which had thus not previously been regulated by legislation.

The first step: physical health hazard studies

Industrial hygiene and ergonomic problems in the working environment were studied in 1968 in a nationwide investigation of "Swedish Trade Union Confederation (LO) Members' Perceptions of Workplace Health Hazards" (Bolinder, Magnusson & Nyrén, 1970).

About four out of five workers believed that their jobs involved health hazards. Half of those who thought so answered "to a high degree". Three types of hazards predominated (below, left): ergonomic factors (loads), physical environment (noise, drafts, temperatures) and chemical problems (eczema).

One out of five workers believed that health hazards at work had resulted in ill health. The same proportion stated that they had a fellow worker with ill health caused by work. The predominant category of illness was diseases of the back and joints, 52 %. After that came hearing impairment, 24 %, followed by skin disease.

In a 1974 study of "Chemical Health Hazards in the Working Environment," (Bolinder, Englund & Magnusson, 1976), 54 % of the 3,729 LO members interviewed replied that they were exposed to some form of air pollution on the job. This was more common at large companies than at small ones. Dust from plastics, wood, cotton, talc, cement etc along with vapors from solvents were the predominant chemical compounds. Slightly less than half of those exposed believed that these chemical pollutants in the environment were hazardous to their health. About 60 % of those who replied in this way gave as a reason that they had noticed the effects themselves. Only about 10 % based their opinion about health hazards on the results of physical examinations or measurements by industrial hygienists.

First trade union stress study

The first major trade union study concerning "Stress at Swedish Workplaces" was carried out in 1971 by LO (Bolinder & Ohlström, 1971). Out of the 3,990 workers who were interviewed, about 1/3 felt that their job was "rather stressful" or "very stressful" and involved psychological demands. One-fourth regarded their job as not as all stressful and psychologically demanding.

There was a positive correlation (r = .60) between psychological strains and psychosomatic ailments. Every fifth worker had "considerable psychosomatic ailments". The predominant psychosomatic stress symptoms were tiredness and digestive disturbances. Other less frequent symptoms were insomnia, nervousness with constant worrying and anxiety, restlessness and depression. During 1970, 12 % had visited a doctor due to ailments which they saw as connected with psychological stress.

The most important reason behind stress or aversion to a job was the hectic pace of work. Other obvious causes of psychological strain were physically strenuous work and physical health hazards such as noise, smoke, drafts and air pollution. Income problems, chiefly in connection with piecework, also contributed to stress and aversion. Furthermore, there was a strong relation between the feeling of stress, on the one hand, and on the other hand the degree of constraint, or feeling that the job was interesting and stimulating. Of those workers with no freedom on the job – 4 % of the interview group – half were under rather great or very great stress. Among workers with more flexible jobs – about half of those interviewed – the proportions were reversed.

Social relations such as communication with and relations to fellow workers and supervisors were the least psychologically strenuous. But of the 7 % who felt there were sharp differences in the treatment accorded to different categories of empolyees, about half said they were under rather great or very great stress, while 1/6 of them felt no stress. Among workers who did not feel there was any difference in treatment of different employees, the proportions were reversed.

Inspiration for white-collar employees

Inspired among other things by the above-mentioned LO report, the Swedish Central Organization of Salaried Employees (TCO) began to work more actively within the working environment field. A large-scale survey of "The Working Environments of White-Collar Employees" (Wahlund & Nerell, 1976), with the emphasis placed on psycho-social conditions, was carried out in 1975.

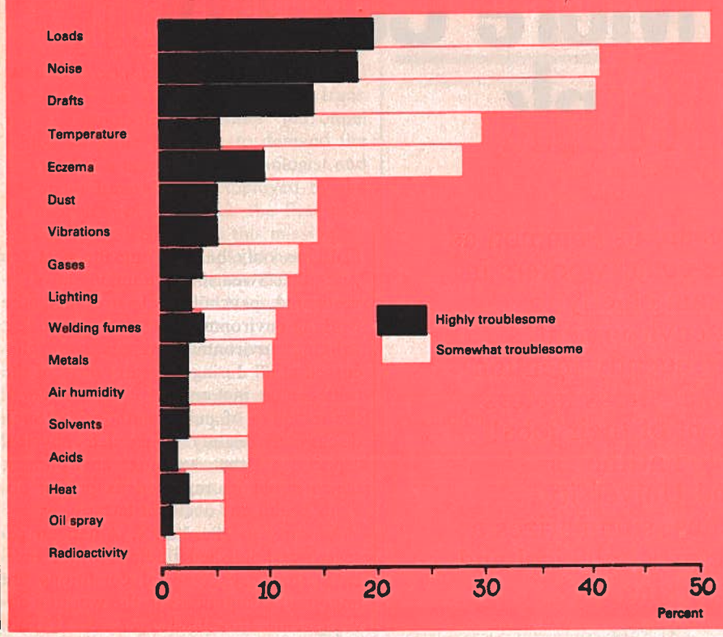
This study revealed that the approximately 12,000 TCO members included in the investigation felt the same degree of psychological strain as LO members. One-third experienced psychological stress at work very often or rather often. Within the employment categories of teachers, police personnel, artistic employees in the theater, journalists and middle-level administrative personnel, 40 % or more regarded their work as psychologically strenuous. One-fourth of the TCO members inteviewed seldom or never experienced psychological strain at work.

Stress can be fun!

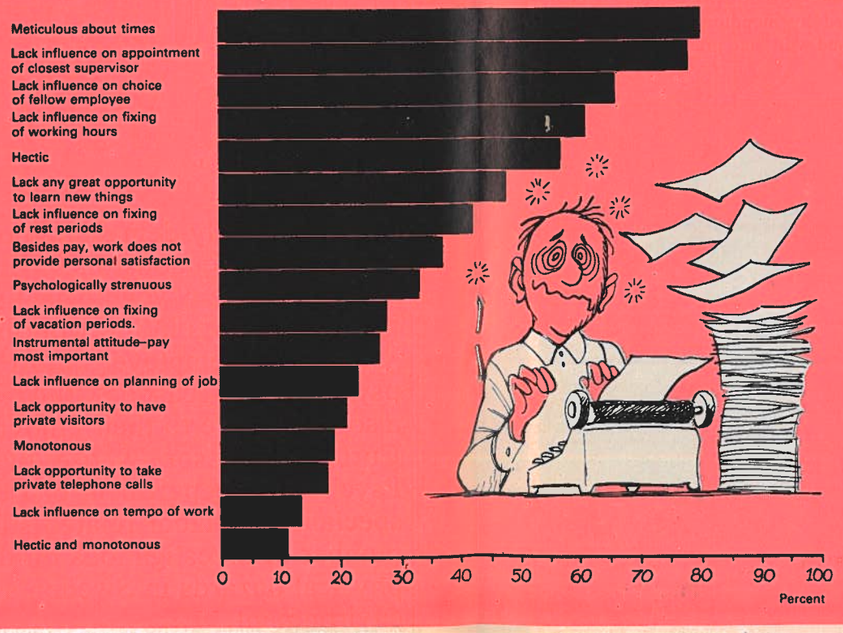
The predominant causes of psychological stress at work were heavy responsibilities and heavy demands for attention and concentration. This was particularly noticeable among the 73 % who felt great personal satisfaction at work. Other causes of psychological strain were the hectic pace – "not enough time" and "too much to do" – and the expectations and demands of customers, patients, students and the general public, i.e. people outside the workplace.

Tho most obvious shortcomings of workplaces were poor ventilation, drafts, temperature conditions, noise and a lack or shortage of resting rooms and staff dayrooms. Unfortunately it was not re-

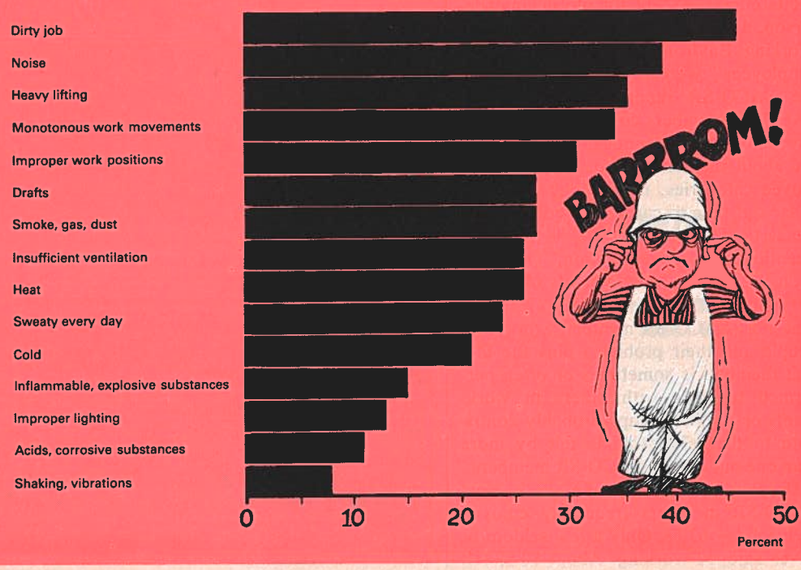
LO Members' Perception of Workplace Health Hazards (Bolinder, Magnusson & Nyrén 1970). Three types of hazards predominated: ergonomical (loads), physical (noise, drafts, temperatures) and chemical (eczema).



Various aspects of psychological working environment experienced by employees aged 16–74. Source: SCB, Living Conditions series, Report 12, Working Environment 1975.



Physical discomforts experienced in the working environment of employees aged 16–74.
Source: SCB, Living Conditions series, Report 12, Working Environment 1975.



ported to what extent psychological stress at work was due to these conditions.

Nervous symptoms most common

Of the white-collar employees interviewed, about 1/10 had a high frequency and 1/5 a moderately high frequency of medical symptoms. Most common were nervous symptoms (38 %), followed by stomach ailments (28 %) and back problems (25 %). Medical symptoms were most common among those who often felt psychological strain on the job or who very frequently felt that they had too much to do at work.

At the same time as TCO, the Swedish Central Organization of Professional Associations (SACO-SR) – whose members are university graduates or the equivalent and include many high-level civil servants – carried out a broad survey of "The Working Environments of SACO-SR Groups", except for physicians (Peterson, 1976). The trends found in "The Working Environments of White-Collar Employees" were even more evident in the SACO-SR report. Nearly half of SACO-SR members considered their jobs psychologically strenuous. Their reasons are about the same as for the TCO employee categories, i.e a hectic pace due to lack of time to carry out a job and too much to do, heavy demands for close attention and concentration, great responsibilities and the demands of people not employed at the workplace. The fact that most SACO-SR members work with people and their problems plus the fact that their job is sometimes or often performed together with others in work-teams or project groups probably contribute to the role conflicts felt by more than one out of four SACO-SR members.

Despite these drawbacks at work, most SACO-SR members frequently enjoyed their jobs – 63 %. Only a few seldom or never enjoyed working. About 80 % felt personal satisfaction with their work. Contributing to this are autonomy on the job and good opportunities to plan one's daily work, freedom to make use of working hours and the absence of detailed supervision and internal supervision.

Nationwide survey

In a nationwide interview survey entitled, "Working Environment 1975", the Swedish Central Bureau of Statistics (SCB) estimated that just over 2.5 million people, equivalent to 64 % of all employees aged 16–74, had a physically strenuous job in at least one of the following respects: heavy lifting, monotonous working movements, improper working positions, shaking and vibrations or daily sweating. The occurrence of various physical factors in the working environment can be seen on page 25. Those with the most physically strenuous jobs were young people aged 16–24 and non-Swedish citizens. Production and distribution employees – especially those in the construction industry – and farmers were the occupational categories most exposed to such strains. Roughly one employee in five regarded his/her job as rather hazardous or very hazardous.

The percentage distribution of various factors in the psychological working environment is shown on p. 24–25. Those with psychologically strenuous jobs numbered 1.3 million, or 33 %. Many employees – especially those at large workplaces, young people (16–24) and non-Swedish citizens – felt that they lacked influence over important aspects of their jobs and working environment. These categories, to a greater extent than other groups, stated that their work is monotonous or both monotonous and hectic. Fewer of them than those in other categories felt personal satisfaction with their jobs.

Interesting differences

The findings of the SCB study indicate some interesting differences between various parts of the labor market. For example, in the private sector there were more people (two out of three employees) who regarded their working environment as physically strenuous than the number (one out of three) who found it psychologically strenuous. Among employees in national government service nearly half stated that their work was physically strenuous and an equal number that it was psychologically strenuous. Local government employees were the ones who saw their working environment the most negatively: 2/3 felt it was physically strenuous and 2/5 that it was psychologically strenuous.

In 1977, Nelander published an interesting description of "White-Collar Employees in Cross-Section" and their working conditions. On the basis of the SCB working environment survey, he made compilations of and comparisons between the working environments of TCO, SACO-SR and LO members. Not unexpectedly, the working environment of white-collar employees was less physically heavy than that of LO members. The SCB's own socio-economic groupings also hinted at this.

The following table shows that a larger percentage of TCO and SACO-SR than LO members regard their working environment as psychologically strenuous and hectic, despite the fact that white-collar employees have greater influence over planning their work and its tempo as well as fixing their working hours. They also have greater opportunities for self-development by learning new things on the job or by undergoing training during working hours. The jobs of LO members are characterized by monotony, in many cases combined with time pressures. ■

	Nelander (%)			SCB (%)
Psychological stress	TCO	SACO-SR	LO	All employees aged 16–74
Psychologically strenuous	47	62	29	33
Hectic	66	60	57	57
Monotonous	9	5	29	19
Hectic and monotonous	6	3	17	11
Total lack of influence on:				
Planning of work	8	1	34	23
Tempo of work	7	5	17	13
Fixing of working hours	54	32	76	61
Have no chance to learn new things	31	12	57	48
Have not taken part in training on working time	54	38	80	–

Company-sponsored Health Services Emphasize Prevention

There are three ways of organizing an occupational health service in Sweden: you can build it into the company, you can establish a joint center for several companies, or you can establish industry-specific health services. Yvonne Wessman explains the structure and function of this important part of the occupational safety system.

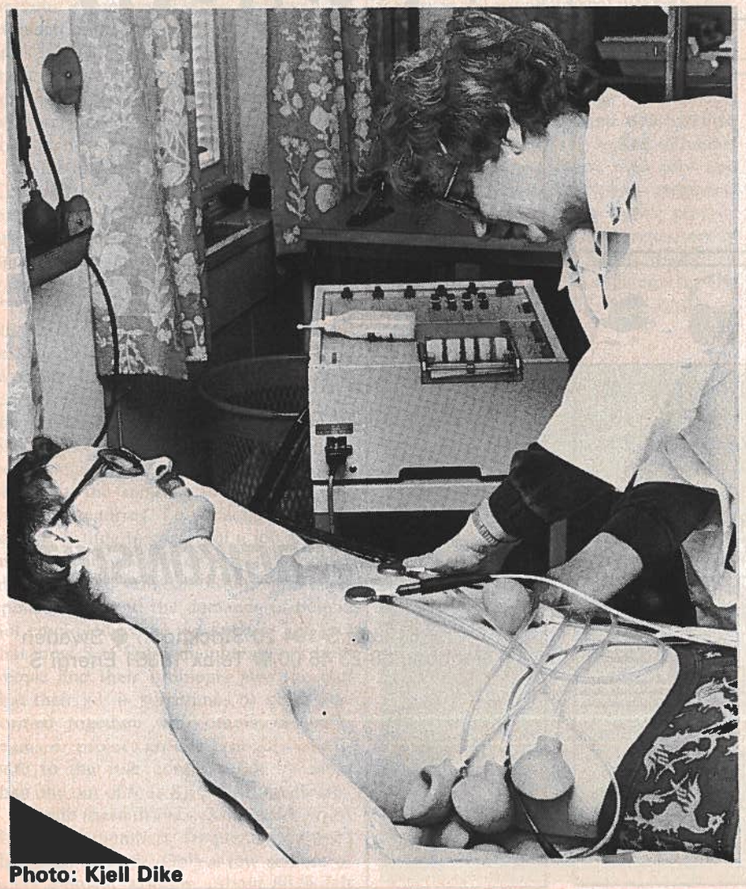


Photo: Kjell Dike

□ Basic medical care in Sweden is mainly the responsibility of the county councils, and all Swedes are covered by national health insurance.

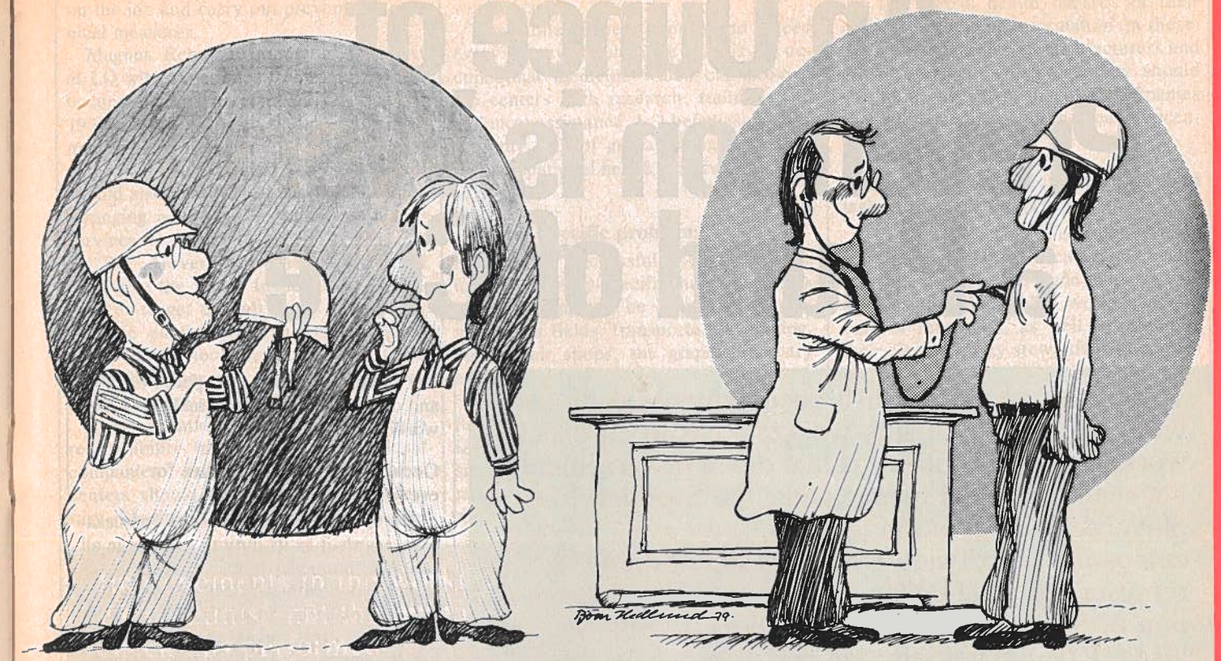
Company-sponsored health services, on the other hand, are part of the occupational safety system. Their aim, like that of this system as a whole, is to improve the working environment as much as possible. The tasks of occupational health services are primarily technical and medical ones with a preventive emphasis, but to some extent to provide treatment of illnesses and rehabilitation.

According to occupational safety legislation, employers are to supply the resources needed to protect the safety and health of employees during work. Part of this is occupational health services.

The health services themselves are not regulated by law. Instead, the expansion of such services is regulated by means of agreements between labor and management. The objective of this process is occupational health services for everyone on the labor market, but the rate of expansion is decided by the employers and employees.

Despite efforts to expand the occupational health services, today fewer than half the people on the labor market in Sweden have access to such services.

The expansion process has gone furthest in the private sector, but much remains to be done in this area. The main question now is extending coverage to small, scattered workplaces.



The tasks of occupational health services

The occupational health services have increasingly evolved toward preventive measures. Agreements and guidelines specify that they should consist of a medical and a technical department. In certain cases—this applies, for instance, to the national government sector—it is also specified that they should provide a psycho-social function. Other agreements emphasize psycho-social aspects but do not stipulate that any special department should exist for these problems.

Occupational health services provide advisory expert functions. They are expected to take initiatives when it comes to occupational health and safety, carry out investigations and contribute in every way to the gathering of background information for the decisions necessary to the task of improving the environment and adapting the workplace to the employees. For this reason it is natural for the occupational health services to collaborate on a broad front with various organizations both inside and outside the workplace.

Three models

In principle there are three ways of organizing the occupational health services:

- ○ Large workplaces should establish their own company health services, serving their employees
- ○ Small and medium-sized workplaces should be served by occupational health centers jointly established by the companies concerned
- ○ In certain industries it is possible to establish industry-wide occupational health systems.

Built-in occupational health services

Nowadays every company in Sweden with more than 1,000 employees has occupational health services, most frequently built into the workplace. Larger municipalities and some of the national government agencies also have their own occupational health services.

Occupational health centers

Small and medium-sized companies are frequently unable to arrange their own occupational health services. For this reason it is common for a number of companies to join in forming a foundation or corporation which operates an occupational health center.

According to the guidelines, it should be possible to establish an occupational health center if there is a population of 1,500 employees wihtin a fairly limited geographical area. It need not prevent collaboration that the companies concerned work in different industries. Private companies, the national and local governments, and other employers frequently join forces in establishing such centers.

During the past ten years, the main expansion of the centers took place. In 1978 Sweden had 209 occupational health centers, serving just over 5,100 employers with more than 580,000 employees. Most of the centers serve companies in a wide range of different industries.

Industry-specific occupational health services

In certain industries with geographically scattered, small or temporary workplaces, it may be suitable to establish occupational health services covering a specific sector.

Sweden currently has only one example of industry-specific occupational health services covering an entire economic sector, and that is Bygghälsan, the Construction Industry Foundation for Industrial Safety and Health. This organization operates throughout Sweden. The country is divided into twelve regions with a total of 28 permanent occupational health centers and 20 mobile units. Operations are managed by the head office in Stockholm. The companies thereby served have a total of just over 200,000 employees.

Existing plans for industry-specific occupational health services indicate that it is likely that organizations resembling Bygghälsan will be created in the transportation industry and for those employed in agriculture.

Automotive service and dealership companies have created some local industry-specific occupational health services, and in forestry and retailing the potential for such services is being studied. ■

An Ounce of Prevention is Worth a Pound of Cure

The main task of Swedish occupational health services is not to treat sick workers, but to cure sick workplaces. This policy is laid down in agreements between labor and mangement: the Swedish Employers' Confederation (SAF) representing private companies, the Trade Union Confederation (LO) representing blue-collar workers and the Federation of Salaried Employees in Industry and Services (PTK) negotiating on behalf of white-collar employees in the private sector.

□ The agreement signed in 1976 states that a company's Safety Committee, where the trade unions have a majority, is responsible for its occupational health service. According to the agreement the employees of the health service–doctors, safety engineers, nurses, industrial hygienists, physiotherapists–have a neutral expert function at the service of labor and management.

A Government-appointed study commission including labor and management representatives has been given the task of planning how everyone in Sweden can gain access to occupational health services on the job. The trade unions are pushing for this with the help of technical experts.

The "company doctor" and the safety engineer are no longer the employer's representatives, but instead occupy a unique position as advisors to both labor and management. They must be objective, which is no longer the same thing as supporting the employer.

Gunnar Westermark, safety and health director of the Swedish Employers' Confederation, says that his organization has only good things to say about how this agreement on occupational health services has worked out:

"By including this rule in the agreement and emphasizing the expert role of the occupational health service, the climate was improved. Before that there were cases where a doctor was accused of playing on the side of the employer."

A national arbitration board has been established to deal with disputes within the occupational health system, but the board is virtually unemployed.

Preventive work is the most important

In Sweden, as in other countries, occupational health began by providing medical care for the employees. Having a doctor at one's workplace was regarded as a fringe benefit–getting free medical care.

Modern occupational health services, however, should be mainly preventive. They consist of a technical and a medical portion. The doctor and the nurse serve as medical advisors in the preventive work done at workplaces, where working environment conditions are analyzed and hazard elimination techniques and ergonomic planning are carried out. It is beginning to be recognized that it is mainly the engineer's contribution that is essential in the preventive work.

"Posterity is not going to judge the occupational health services on the basis of how many check-ups they've done, but on what they've accomplished in the way of improving the working environment," says Gunnar Westermark.

According to the agreement the occupational health services should no longer concentrate on general physical examinations. The important thing is to be able to take preventive steps based on both medical studies in the case of special hazards and on thorough technical analyses of the working environment.

Occupational health service for everyone

The Swedish Employers' Confederation regards it as its duty to encourage all member companies to provide decent occupational health services either within the workplace or, in the case of smaller companies, by means of occupational health centers serving a number of companies.

Today all SAF member companies with more than 1000 employees have built-in occupational health services, covering 500,000 employees. The 230 occupational health centers in the country provide services to an additional 600,000 employees of small companies. There is also a nationwide occupational health service for the construction industry, Bygghälsan, covering about 200,000 employees.

There are about 700 industrial physicians, a similar number of safety engineers, 1900 industrial nurses and a few hundred physiotherapists working within the occupational health system.

More than 75 % of employees in companies affiliated with SAF are covered by preventive occupational health services. The aim is for all employees to have such services. The bottleneck is in training of personnel, which is mainly the task of the public sector.

In addition, doctors are still unable to obtain the same sort of specialist qualification in occupational health as they can in such fields as surgery.

The labor inspectorate is responsible for small workplaces

The biggest problem so far has been in trying to bring very small workplaces into the preventive occupational health system. Collaboration with the public health care system, which in Sweden is run by the 23 county councils, seems to be the only way of reaching small enterprises in remote areas. But so far the general health service run by the county councils has had neither the time nor the expertise to locate the causes of ill health on the job and carry out preventive technical measures.

Magnus Rehn, an industrial hygienist at LO with experience from industry and occupational health centers, says that the 19 regional boards, including labor and management representatives, which are responsible for the Labor Inspectorate, should also be assigned responsibility for arranging access to occupational health services for all employees.

"The Government and Parliament must give the Labor Inspectorate the resources to get the job done. The unions and the employer organizations should see to it that local employers and trade union branches are activated into demanding these services."

The occupational health centers have a responsibility to see to it that all local companies become members. New centers should be started where necessary. Medical services could be bought from the counties for small, remote workplaces.

Every one of the 7 regions and indeed every county should have a clinic for occupational medicine which can provide the centers with research, training, and technical assistance, LO believes. This is the only way of guaranteeing quality to the occupational health services. See also page 17.

Industry-specific problems

Using the successful Bygghälsan as a model, industry-specific health services are beginning to be established in a number of fields: transportation, mining, auto repair shops, the graphic industry etc.

"We don't want to recommend any further expansion of these vertical organizations," says Magnus Rehn. "Bygghälsan has a well-defined role because of the nature of the construction industry. But the other industry-specific health services ought to concentrate on investigating the special health hazards of their industry, providing information on these, and keeping an eye on manufacturers and public agencies. Otherwise they should see to it that their member companies around the country join the nearest occupational health center."

Trade union education will help lend weight to these demands

The new Working Environment Act and the agreement on occupational health services also give the trade unions a role in decision-making when workplaces are built or renovated, as well as providing their elected safety stewards with considerable powers.

The white-collar trade unions are trying to convince the Government and Parliament to accept their responsibility to recruit and train personnel for occupational health services. At its congress in June, the million-member Central Organization of Salaried Employees (TCO) adopted a report entitled "Expand Occupational Health Services!"

PTK's environmental group has been pushing hard. Its chairman is Sigvard Ländin, negotiating representative of the Swedish Foremen's and Supervisors' Union (SALF).

"To lend weight to our demands, we have to increase the level of knowledge among our representatives in company safety committees and occupational health committees," says Ländin.

"We'll also have to provide broad general information to our members about the aims and methods of occupational health services. Because among white-collar employees, just as among LO members, there are people who don't see the occupational health services as preventive, but rather as a staff welfare and medical care program. We can't correct that misinterpretation without sending information to our members."

Stress–a white-collar problem

What special health hazards are white-collar employees exposed to?

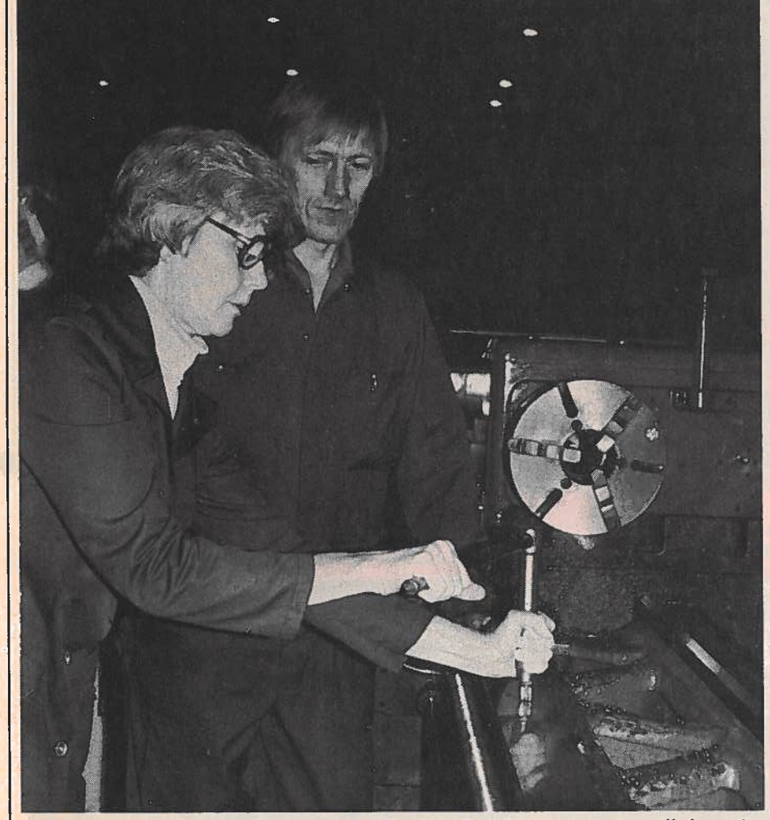
"We get an upset stomach and a headache and feel generally under stress. It may be anxiety about changes on the job at times of reorganization and efficiency measures", says Ländin.

"Responsibility, demands for close attention and concentration and time pressures are mentally strenuous, but the strains are difficult to identify and measure. In addition, white-collar employees frequently work in small rooms together with many other people."

"If we compare these white-collar problems with the exposures and hazards of industry, they may seem small. But it can be harder to 'patch up' a shattered mind than to stitch up a wound or treat a bad back," Sigvard Ländin believes.

Ann-Charlotte Viklund

Improvements in the working environment are what counts–not the number of general medical check-ups performed



Much preventive medicine work can be handled by a nurse in collaboration with the safety committee.

Karin Dalén, occupational health nurse at Sunds AB Emba in Örebro, discusses the design of a handle for a screw thread tool with Bernt Öhrn, mechanic.

Where the Money Comes From: ASF

New emphasis on training at small companies and on conferences

All employers, private and public, pay a fee equivalent to 1/10 % of their total payroll to the Swedish Work Environment Fund (ASF).

By Jan Enqvist

As a result, during 1978 ASF was able to grant 105 million kronor to research, development, training and information in the working environment field.

Most of the money, more than 60 %, goes toward research and development. But the Fund now also has strong commitments to training and information.

ASF's activities are expanding. For this reason 1978 is not a typical year. Roughly 200 research reports were submitted to the Fund that year. There were fewer the previous year. In 1979 the number will be larger.

The reports deal with all aspects of the labor market, from ergonomically well-designed drivers' seats to employee participation in decision-making and issues concerning democracy within companies.

But how do research findings gain an impact on real conditions out on the labor market?

Sometimes through the Occupational Safety and Health Administration, the national government agency responsible for issuing regulations and providing supervision in this field. But in line with efforts to create greater democracy on the labor market, there is also an ambition to disseminate research findings more directly, by means of training and information programs.

ASF finances training activities which are expected to cost around 41 million kronor during the financial year 1979–80. The 41 million is distributed as follows: production of study materials about 9 million kronor, implementation of basic training for safety stewards and foremen (16 million, paid to various adult education associations and industry organizations so they can offer training free of charge to participants), advanced training 12 million kronor, and instructors' training about 4 million kronor, which is spent in an effort to make people pedagogically qualified to lead study circles on the basic and advanced levels.

A lot of people involved

"This training commitment, if we look back over the years, is apparently the biggest of its kind ever undertaken on the labor market," says Roland Bolin, who administers training matters at ASF.

"We've skimmed the big companies and trained foremen and safety stewards from them. Now various activities are going on to form study circles with participants from a number of small companies in the same town or nearby towns. The alternative, residential courses with participants from throughout the country, is too expensive."

The key phrase in the program is "A Better Working Environment." This is the title of the course package as well as its aim (see also page 36).

The study material is financed by the Work Environment Fund. Its contents are produced by the Joint Industrial Safety Council. Brevskolan, the correspondence institute of the labor movement, edits the material and has it printed.

"We want study circle participants from small companies," says Roland Bolin.

"We'll be concentrating on conferences," says Ylva Tivéus.

"Now the trade unions have to mobilize the safety stewards and foremen in small companies so the training program will achieve full coverage," says Roland Bolin.

A program aimed at planners

"We're also operating a pilot project to train architects, design engineers and others who influence the working environment at an early stage–before work takes place there. These are new target groups, and our pilot groups have received specially-tailored courses, adapted to the private and public sectors respectively."

Conferences involving researches and labor market rerpresentatives

"To a greater extent than before, we'll be concentrating on various types of conferences", says Ylva Tivéus, information secretary at the Work Environment Fund. "A completely new program is our series of conferences for regional safety stewards in a trade union district and researchers working on projects in that area. This will solve the problem of getting research findings out to small companies, while researchers may also pick up new ideas."

The first conference of this type will be organized in the retailing field during the autumn of 1979. Around that time there will also be a number of three-day seminars for people working in occupational health. This is a pilot project and various working environment problems will be discussed in different fields–which ones are as yet undecided. The proposals now at hand are:

- categories of chemical substances
- categories of biological factors (bacteria, viruses, fungi)
- closely-related physiological factors
- the length and distribution of working hours
- industry-specific problems etc

with measuring techniques included in each area.

Conferences for trade union representatives

"We are also going to sponsor conferences for trade union representatives and researchers," says Ylva Tivéus. "This is a way of quickly making research findings known while giving researchers a chance to establish contacts with the unions and each other. At least two such conferences will take place in the autumn of 1979, one on working environment problems related to computerization, and one on the climate in drivers' cabs.

"Another campaign this fall concerns lighting. Just as we previously brought together findings from various noise projects, we're now going to examine a number of projects in the field of lighting, where we know that a lot needs to be done," says Ylva Tivéus. ■

Invisible Poisonous Gases Spotted with New Method

Most ventilation systems function perfectly–as long as there are no people on the premises. But as soon as someone enters a room–and starts to move, breathe, work–the system is disturbed, in the worst cases so much so that people "poison themselves." A Swedish research team was the first to demonstrate this with the help of a movie film and infrared techniques.

□ Air movements are considered to be of great significance when determining the level of air pollution. For example, turbulence in a workplace can create very strong and dangerous concentrations of pollution.

Previously, it has been possible to detect the spread of particles in the air with the help of smoke. Random checks can also be made of gas concentrations in the breathing zone of persons working in specially exposed workplaces, for example.

However, it has not been possible to acquire an understanding of the spread of invisible gases.

Now, a research team at the Department of Heat Technology at the Royal Institute of Technology in Stockholm has succeeded in filming invisible gases with the aid of infrared techniques. The team – headed by Professor Claës Allander – is the first in the world to achieve this.

The majority of dangerous gases are invisible to the human eye, but they are so constituted that it is possible to detect them with infrared techniques. This is because the gases absorb radiation in the infrared field on their characteristic wavebands. This means that it is possible to produce so-called extinction pictures, which reveal gas concentrations in the area of distribution.

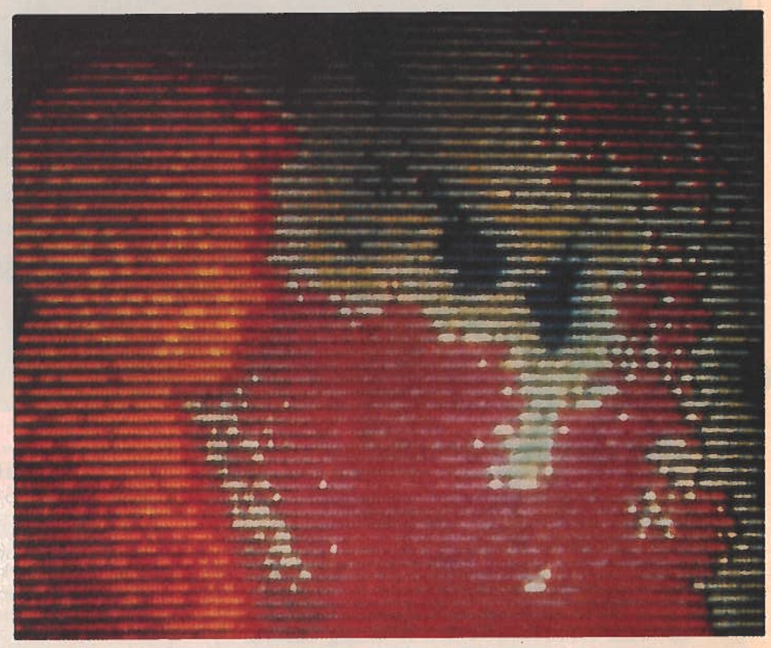
Initially, the research team constructed experimental equipment which, with the help of an infrared camera, enabled them to make a black-and-white film strip of gas distribution. The gas used in the experiment was nitrous oxide (laughing gas), which is a little heavier than air and quite harmless.

The next step was to film gas distribution. In this manner, researchers could obtain information on gas movements in a room.

The filming stage was dramatic–and gave food for thought. When the room was empty the gas settled at the side of the room, but when there was a person in the room the gas spread out like a large cloud, directed towards the person's nose and mouth–a complete surprise for ventilation engineers.

Filming took place with a color monitor, i.e. a certain color is equivalent to a certain extinction.

The object of the experiment is, of course, to enable labor inspectors and testing officers to pinpoint the distribution of dangerous gases in workplaces. Work is now in progress to develop the infrared method of detecting invisible gases so that it can be used in practice. ■



This photograph was taken using infrared technique and shows the distribution of laughing gas, otherwise invisible to the eye. The colors of the gas, next to the orange silhouette, represent different concentrations. Black means no gas at all, blue the smallest concentration, and then it increases in the following order: green, red, yellow and white.

The Self-Propelling Training System

The most efficient way to achieve a better working environment is to act on knowledge. Knowledge of what is wrong and how it can be changed.

Hence the importance that Swedes attach to safety training of all categories of employees.

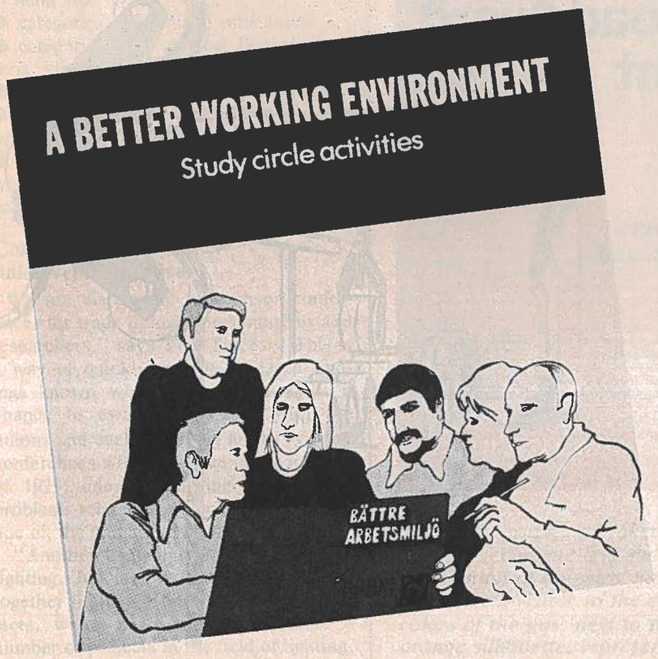
The training of safety stewards mostly takes an unusual form—that of the study circle. The study circle idea, in turn, is a prerequisite for the unusually wide scope of this training.

□ "The philosophy behind Swedish working environment training is different from most other educational philosophies – in Sweden or elsewhere," says Ingvar Söderström, head of the Joint Industrial Safety Council.

"The aim of the game is to enable employers and employees to solve their own problems, right on the spot, without outside interference. To put it a bit disrespectfully, the working environment is too important to be fiddled with by the State or to be taken over by bureaucrats of one persuasion or another."

"Therefore," Ingvar Söderström continues, "we want to train safety stewards to argue for and prove the value of changes in their own working environment—in front of their own employers."

"And the best way to achieve this independence, we think, is to create a self-propelling training system."



Easier said than done?

Well, yes.

But here's how it began, back in 1974.

The right of safety stewards to receive training was established by the Workers' Protection Act and complemented with an agreement between the trade unions and the employers' associations.

The agreement contained two most important points: The first was that training is to take place during paid working hours.

The other was a working environment training model in three stages: 20–40 hours' basic training, followed by advanced training and supplementary activities. Safety stewards and foremen are the principal target groups of this training.

But how could employers agree to this?

"I think it's precisely the existence of a philosophy that persuaded them," says Ingvar Söderström. "You can prove—as far as this kind of thing can be proved—that the cost is outweighed by the advantages of a better production environment."

The basic course

The model from 1974 was developed into a basic training course for the entire labor market. It was entitled "A Better Working Environment" and compiled by the Council in collaboration with the trade unions, the employers' associations and the National Board of Occupational Safety and Health.

The course emphasizes practical work. Theoretical studies are alternated with practical exercises, film strips and visits to the participants' own workplaces.

"It's an unusual course," says Ingvar Söderström. "Especially because of the way it is used. It is designed to be used in that most Swedish form of education—the study circle."

No need for teachers

Study circles have been used for a long time in adult education in Sweden and are a pedagogical technique well suited for studies of the working environment.

The participants in a study circle all take part in the planning of the course, adapting it to their own interests and needs. The place of the conventional teacher is taken by a "circle leader." His or her job is to present problems to be solved by the group and keep the discussion moving.

This method has many advantages—above all, it is as close to self-propulsion as you can get.

- It makes everybody in the group active.
- It demands a minimum of specialist assistance.
- It runs at its own speed, chooses its own order of chapters to be studied, etc.
- It can be adjusted to the specific problems of each particular company or organization.

The members of the group meet regularly, for example once a week for three hours.

Planning on the spot

This does not mean that other forms of study are not used in environmental training. Conventional teaching also exists, above all where working conditions, geographical problems, the size of the firm etc. make it impossible to use the study circle.

But whatever the form, the studies are planned in the safety committee, or if the firm is not big enough to have a committee, directly between the employer and the trade union locals within the firm. Courses can also be arranged in cooperation with adult education associations, or by state and municipal bodies.

Three steps

"But there is more to the philosophy," says Ingvar Söderström. "For example, only one training course is not always enough."

For this reason, the training program has been divided into three steps. The first is basic training which, ideally, all safety stewards and foremen take part in.

The second step allows the student to receive advanced training, which—and here the philosophy comes in again—should be adapted to the character of the workplace. That is, if chemical hazards are considerable, the training course emphasizes chemical matters. Thus those trained will be able to react quickly and adequately to the risks prevailing in their particular company.

For those who want further training there is step three, the purpose of which is to prepare the students for unpredictable hazards and emergency situations.

"However," says Ingvar Söderström, "we have not had the same success with the more advanced courses as with the basic one. Maybe our information activities have not been adequate."

Illustration from the course book: »Safety stewards have the right to interrupt dangerous work.«

Skyddsombud har rätt att avbryta farligt arbete.

300,000 copies distributed

By the end of 1974 about 80,000 people had taken the basic course. Today more than 300,000 copies of the course have been distributed.

This means that a large proportion of Sweden's 118,000 safety stewards have already taken part. The present rate of distribution is about 30,000 a year.

Who pays?

These extensive training projects would not have been possible without financial support from the Work Environment Fund (see page 32).

The basic course material, for example, is a file of well over 200 well-illustrated pages divided into 10 blocks. It is sold at a very low price and distributed free of charge to all safety stewards who take part in the course.

But grants from the Work Environment Fund represent only a portion of the total cost of training. As a result of the agreement between the trade unions and the employers' associations concerning training during working hours, the bulk of expenditure is borne by the company.

If compensation for lost earnings is also included, the total training cost since 1974 has been roughly 800 million kronor.

A condensed English version of the basic course is now being prepared for use in developing countries, at the initiative of the Swedish Metalworkers' Union and in collaboration with the Swedish International Development Authority (SIDA). SS

The Joint Industrial Safety Council (Arbetarskyddsnämnden) is the joint working environment organization of The Swedish Employers' Confederation (SAF), The Swedish Confederation of Trade Unions (LO) and the Federation of Salaried Employees in Industry and Services (PTK).

The main duties of the Council are training, information, investigation and consultation—with heavy emphasis on training.

Its main target groups are employees and employers in the private sector, as well as in municipalities and county councils.

The Swedish Government Work Environment Council (SAN) takes care of the national civil service sector on basically the same principles as the Council takes care of the private sector and local government.

The National Board of Occupational Safety and Health (Arbetarskyddsstyrelsen) is responsible for the training of company health service specialists etc. Higher education in the field is also provided at several universities.

Report from a Study Circle

"The kitchen help knows a lot more about the working environment of the kitchen than the architect who designed it," Ingrid taught us.

By Siv Söderlund

□ We gathered one cold and cheerless morning in February–a timid little group of eight safety stewards-to-be. We looked at each other suspiciously as Swedes do when they do not know each other, and nobody talked.

Our "circle leader," Ingrid, made coffee for us and said we must introduce *each other*–after a short on-the-spot interview with our neighbor at the table.

The trick worked, the ice was broken, and we learned that most of us were school teachers and day nursery assistants in the municipality of Huddinge in suburban Stockholm. And all yearning to learn more about the important task of being a safety steward.

Ingrid, we soon found out, was one of Huddinge's most respected senior safety stewards, qualified through many years of controversy with her employer–the municipality–over matters of health and safety in the school lunch room where she had her daily work.

She gave each of us a fat file containing the basic course "A Better Working Environment," and off we went.

Tough stuff

The first lessons were devoted to studies of the safety organization of the municipality and of the Swedish working environment legislation. Pretty tough stuff.

Ingrid handed out written questions. In order to answer them we had to really penetrate the paragraphs of the Working Environment Act and discuss them between us. Very smart, we thought.

One lesson included the difficult art of handling architects' drawings. Ingrid had brought an authentic example–the drawings for a new school that she and the other safety stewards at her school had been asked to express an opinion of. In fact, safety stewards have a legal right and duty to influence the design of new buildings, so this is an important point.

From what we saw at first as several square meters of messy lines, the outline of a school slowly emerged–including a day nursery and a youth center.

But what could *we* say about it?

Ingrid put us on the track. Did the layout include wide enough passages to carry wood into the workshop?

Our carpentry teacher fell into deep thoughts.

Had the locker rooms been placed between the entrance and the kitchen, or will the kitchen staff have to run through the kitchen in order to change clothes?

Things like that, that the architect might not have thought of.

Which, in fact, he hadn't.

Fifth lesson: ergonomics. A still film demonstrated how to lift and carry without straining backs and how to arrange an ergonomically adequate workplace.

Experience from the field

A new face appeared the next time–that of the safety engineer of the occupational health center of Huddinge. He demonstrated his equipment: the noise meter, the light meter and the dust meter, and gave us some idea of their use. And shared with us some of his experience from the field:

"In this community I find that one of the biggest problems is faulty ventilation systems. In the public library for example, the air is exchanged far too frequently. The result is–apart from an unpleasant draft–a great waste of energy in the winter. But it is difficult to make those who hold the purse strings understand that quite a small adjustment may lead to considerably improved working environment."

Our next lecturer from outside was the psychologist from the local occupational health center. A young man with high ambitions, but whose subject met with certain suspicion from the group. Psycho-social environment is a new concept and not easily accepted.

Said one teacher: "For my part I feel that asking the help of a psychologist would be to admit failure."

Teachers admit difficulties

Still, the psychologist said, more and more teachers admit nowadays that they have difficulties in class–kids being what they are. Continuous harassment from adolescent students is really a kind of hazardous working environment.

So the psycho-social bit is possibly the most important of all to a school safety steward.

Work site inspection, according to the course program:

For Ingrid it was natural to show us her own place of work, the school kitchen, which prepares several thousand lunches a day.

We were to study it from the points of view of ergonomics, noise, lighting, chemical hazards, job safisfaction, etc.

Since the school is fairly new, the physical problems were not enormous. It was, in fact, "a clean, well-lit place" with modern equipment.

"The dishwasher is sometimes very noisy," one woman said. "And it's sometimes freezing colk in the room where we prepare the vegetables."

One really big problem remained unsolved–the heavy 20-kg milk packs that had to be brought into the lunch room and placed in a dispenser.

Once more we left our ordinary classroom–this time to visit the occupational health center, meet its staff and learn more about its activities.

When we met for the last time to summarize the course it was the beginning of May and spring had arrived.

Ingrid served coffee with her very special home-made cake and we all felt rather sad that it was all over.

"Do you feel any wiser now?" was Ingrid's concerned question.

Well, the idea was not to make environmental experts of us, and we weren't. But we certainly had learned the basics of safety work and–perhaps more important–where and how to obtain more information in case we needed it.

Which is no small achievement. ■

Circle leader Ingrid Hall has found a particularly exciting passage in the course book "A Better Working Environment."

School teachers-safety stewards Lena Ranndahl and Staffan Sorsén peruse architects' drawings.

Organizations Galore

□ Some 70 public and private organizations are engaged in work environment issues. Here are some of them (with postal addresses).

The National Board of Occupational Safety and Health (S-171 84 Solna) is the central agency for work environment issues. The board's *Supervisory Department* publishes directives on the equipment of machines, the handling of chemical substances, etc. The board also has a *Department of Occupational Medicine* and an administrative department. *The Labor Inspectorate* also falls under the jurisdiction of the board. There are 19 inspectorate districts spread out over the country.

The Swedish National Product Control Board (S-171 20 Solna) tests substances and products. *The Work Environment Fund* (Sveavägen 166, S-113 46 Stockholm) grants money for research. See also page 32. *The Board of Urban Planning* (P.O. Box 22027, S-104 22 Stockholm) among other things publishes directives on the construction of new factories. *The Joint Industrial Safety Council* (P. O. Box 3208, S-103 64 Stockholm) specializes in training. See page 37. So does the *Swedish Government Work Environment Council* (S-103 10 Stockholm). See page 37. *The Swedish Center for Working Life* (P.O. Box 5606, S-114 86 Stockholm) does research with emphasis on the application of the co-determination-at-work act. And the *Swedish Work Environment Association* (Kungsholms Hamnplan 3, S-112 20 Stockholm) sells most of the safety signs and posters used in industry, and publishes the leading safety and health journal in Sweden, *Arbetsmiljö*. You're now reading its international edition, *Working Environment*. ■

NEW LANDMARK FOR BETTER JOB ENVIRONMENT.

Third international trade fair, "Arbetsmiljö 80".
Many forces are at work to make present day and future working environments as safe as possible, and these efforts will be shown at the third international trade fair on the working environment, "Elmia Arbetsmiljö 80", in Jönköping, Sweden, September 15–19, 1980.

Trade exhibition
The trade exhibition will cover complete work settings as well as solutions to specific problems in offices, workshops, schools, hospitals, shops etc. Fitments and equipment for individual and collective protection will also be shown.

Conferences
The conferences have been planned in consultation with the foremost Swedish experts in this field and will deal with subjects such as: psycho-social factors in the future working environment, appraisal of efforts within the working environment field from a social and business economics standpoint, ergonomic problems, the problems of the computer workplace, and risk and security analyses.

For further information, please complete and send in the coupon to: Elmia AB, Box 6066, S-55006 JÖNKÖPING, Sweden.

We would like further details on "Elmia Arbetsmiljö 80".

Company: _____

Contact: _____

Address: _____

_____

Country: _____

AM 108/77

ELMIA ARBETSMILJÖ 80

September 15–19, 1980, Elmia AB, Jönköping, Sweden.
Tel. 036–119060. Telex S 70164. Telegrams Elmia.

Sound-absorbent sheeting protects road workers

□ The road worker's environment is dominated by noise and pollution. And they dominate the road worker's complaints about his job.

"The best solution is to remove traffic from the road worker's place of work," says Nils F. Petersson, an engineer at K-konsult, Stockholm, "but this collides with other considerations. So we must do the next best, which is to try and protect the road worker. And, at least as regards noise, we have made good progress with conventional sound-absorbent sheeting."

A noise-level reduction of 6–8 dB (A) has been achieved at road workplaces by setting up sound-absorbent sheeting on vertical frames between traffic and workplace. Prior to setting up the sheeting, the noise level was about 75 dB (A).

"This is a significant reduction," says Mr Petersson. "In addition, you create a separate environment for the road worker. He does not have to see the cars flashing by all the time. The sheeting also functions as a set of blinkers."

It is also intended as protection against exhaust fumes. How effective this will be is uncertain, because the results of an investigation into the matter are not complete. "However," says Mr Petersson, "if the workplace is a hole the exhaust fume level will certainly be lower. And regardless of the workplace, experiments show that the exhaust fume level will not be higher." ■

K-Konsult
Liljeholmstorget 7
S-117 43 Stockholm

Flash lamp for firemen

□ A xenon gas tube is the main component in a flash lamp used by fire brigades all over Sweden. The lamp is powered by a 5.6-volt battery and provides short, extremely intensive flashes with a frequency of 50/min. Thus, it is not difficult to locate the flash lamp and its carrier, not even in a smoke-filled building.

The lamp is attached to the fireman with a gripband (on the right arm of the man in the picture) before he enters a burning building. It has been used to advantage by all Swedish fire brigades.

It was originally developed for divers, but due to its special characteristics it has been found useful in several other activities, including leisure pursuits such as mountain climbing, boating, hunting, etc. In clear weather, the flash can be seen 10 kilometers away.

The lamp weighs about 250 grams and has an operation time of about 8 hours. ■

MN-Konsult Jotron AB
P.O. Box 2080
S-435 02 Mölnlycke

Much air—little noise—no drafts

□ K-konsult, Gothenburg, has developed air-inflow equipment which is manufactured and sold by Gavle Verken AB. It allows large amounts of air to be distributed around a workplace without causing drafts. In addition, it is soundproofed.

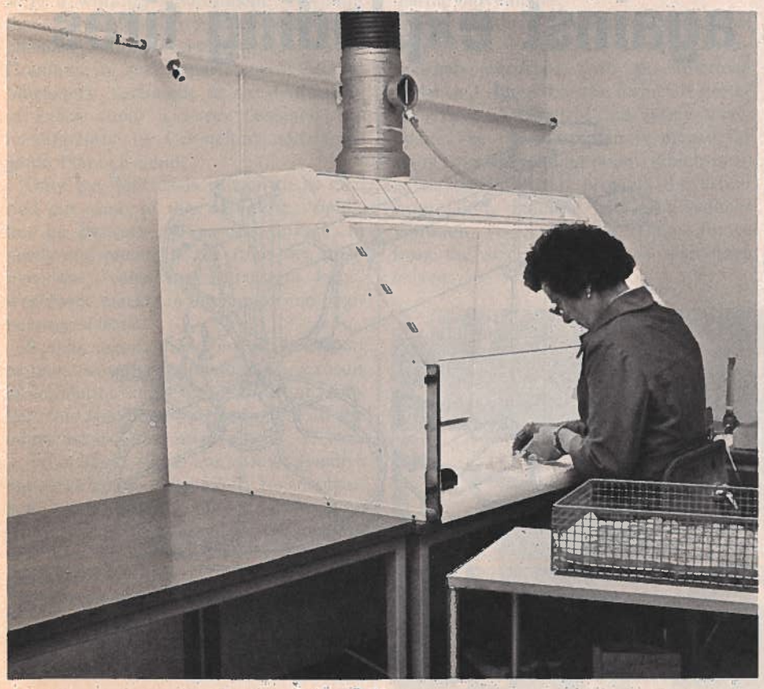
It is based on low-impulse delivery of fresh air. The effect is particularly good in premises with high ceilings, since the fresh air is then somewhat cooler and thus remains in the lower zone where people are.

Air is equally distributed over the equipment's front via a special spinning nozzle placed on a central distribution pipe. Capacity is 1,000 m^3 air/m^2 front surface per hour, which is equivalent to an air speed of 0.28 m/s at the front.

The equipment can be assembled with sound-reducing covers of various types, including those with the same outer appearance. With "walls" of this type, problems connected with draft from doors, etc., can also be solved, in addition to noise problems. ■

Gavleverken AB
P.O. Box 967
S-801 33 Gävle

Fume cupboard meets rigorous environmental demands



□ Stig Gauffin and Bo Löfgren of the Swedish School of Arts, Crafts and Design (Stockholm) have developed a small fume cupboard which meets rigorous ventilation and ergonomic standards. Several of these cupboards can be connected to make a longer cupboard.

Among the cupboard's ergonomic features are the following:

–Angled front, making it easier to work far inside the cupboard, and reducing the risk of disturbing the view of the work area and reflection from windows.

–Lighting fixtures placed deep in the cupboard, which cuts the risk of dazzle and reflection.

–No shiny surfaces.

–Opal glass in front of the electrical fixtures, which reduces the risk of sharp contrasts.

Among the ventilation features:

–Rounded edges with guide vanes which provide a laminary flow inside the cupboard.

–Extraction of air via the cupboard's roof and back edge.

–The possibility of connecting ventilated waste containers and storage spaces. ■

Vertically adjustable, tiltable, rotatable welding positioner

□ "The welding positioner we needed didn't exist. We had to make it," says Ove Hultdin, acting president of Hultdins Verkstads AB in Malå. But now it does and could be useful in many other companies.

It's vertically adjustable, to suit both the tall and the small.

And tiltable, so that all joints can be welded as horizontal joints. This provides a better working position and economy than vertical welding, which requires a lower current and more delicate electrodes.

It's rotatable as well—i.e. equipped with a circular feed.

"We needed a good welding positioner because of our production line—many different products and short series—and in order to create an easier working environment. However, after visiting the welding fair at Essen in 1977 we realized that those that existed were large, cumbersome and expensive. The welding positioner we needed was not on the market."

So Hultdins decided to build their own.

It consists of a stand with an adjustable arm, on which is a tiltable peg. On the peg you can fix a welding positioner, a flat board or a fixing plate. Movable parts can be controlled with a programable steering system. This makes it possible for the welder to program a work-cycle which provides the best working position for the welding operation in question.

The positioner can be tilted to 35 degrees backwards and 45 degrees forwards. Another feature is a hole in the middle of the positioner, through which you can assemble a swivel for the hydraulic locking and unlocking of fixtures.

Naturally, the positioner can be used for other operations: assembly, renovation, cleaning foundry details of excess metal, etc. ■

Hultdins Verkstads AB
Skolgatan 12
S-930 70 Malå

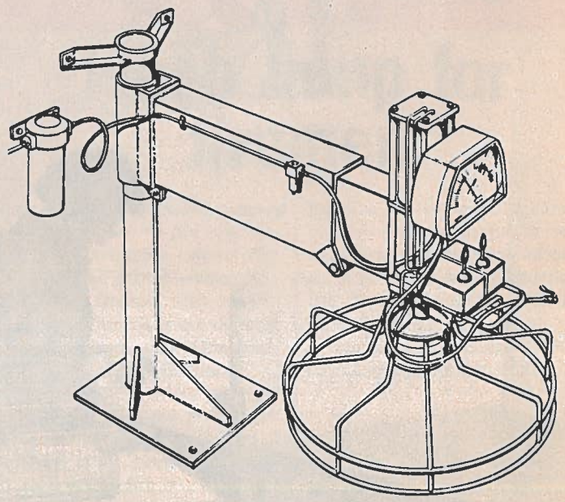
Box protects against exploding tires

□ If a tractor or truck tire explodes while being pumped direct on the workshop floor the explosive force is directional and the risk for personal injury is high. Several serious accidents have happened in this way.

In order to drastically reduce the risk, Lars Åke Jonsson has constructed a pneumatic, vertically adjustable protective box mounted on an arm. While being pumped, the tire is lifted—but should it anyway explode the box catches the bits which would otherwise fly about the premises.

The wheel is placed on the floor, the box lifts it up and rotates it until the pumping position is reached, the tire is pumped, the wheel is lowered. The pneumatic equipment can accommodate tires weighing up to 400 kg. The position of the tire on the floor vis-à-vis the box is not important, since the box's arm is turnable and the arm-length adjustable.

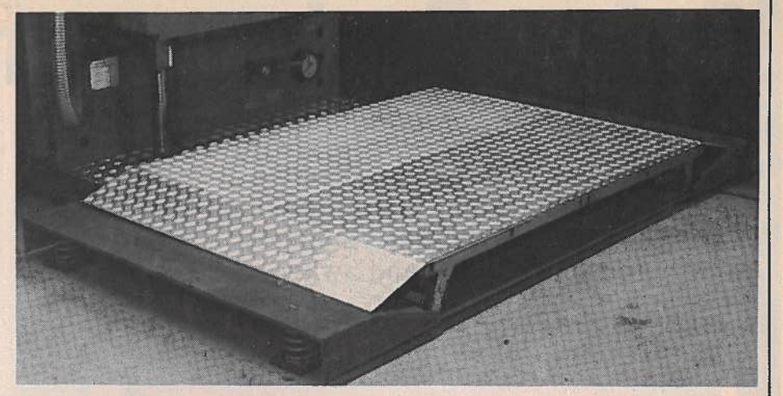
The stand can be mounted on the floor or on a wall.



The box has an air bell for automatic pumping and has been approved by the Swedish Inspectorate for Pressure Vessels and Lifting Equipment. ■

Centralringen
Vintergatan 25
S-902 54 Umeå, Sweden

Vibration-insulated do-it-yourself platform



□ A low, light-weight vibration-insulated platform has been designed by IVF (the Swedish Institute of Production Engineering Research) in Gothenburg. It is primarily intended for forges, which have vibrations with a high top factor, but will be just as useful in connection with pressing, key-punching, etc., where low-frequency vibrations occur.

At the moment, the platform exists only as a prototype. It consists of a reinforced plate with a sunk middle, surrounded by vibration insulators. Natural frequency is as low as 3–4 Hz.

"We have tested various insulators," says Jan Back of IVF, "but the one we are most impressed with, which has a wire construction, has not yet been put on trial. We are also trying to solve problems connected with levers."

During the autumn a report will be delivered concerning the platform. It will contain detailed drawings, so that companies which have problems with low-frequency vibrations can manufacture the equipment themselves. ■

IVF
Mölndalsvägen 85
S-412 85 Göteborg

Improved scaler for work in mines

□ "More robust and better designed from a working environment viewpoint than the equipment now used for mechanical scaling," says Professor Sven Granholm of the Department of Mining Machinery Technique at the University of Luleå about a scaler designed and manufactured by Gruvteknik and Grangärde Plåt och Smide.

Only the field trials remain to be carried out—and, in this case, the "field" lies far beneath the earth's surface, in newly-dug mines. If the trials are positive, the scaler may attract a large, worldwide market in the mining and engineering sectors.

Scaling means that you pry, break off or tear away the fragmented (as a result of detonation) mine wall and ceiling. Earlier, this was done by hand—with all the injury hazards that involved.

At present, there are a few Swedish mines which have machinery for mechanical scaling. Usually, they are excavators which have been adapted for the purpose and they are not especially suitable for the task.

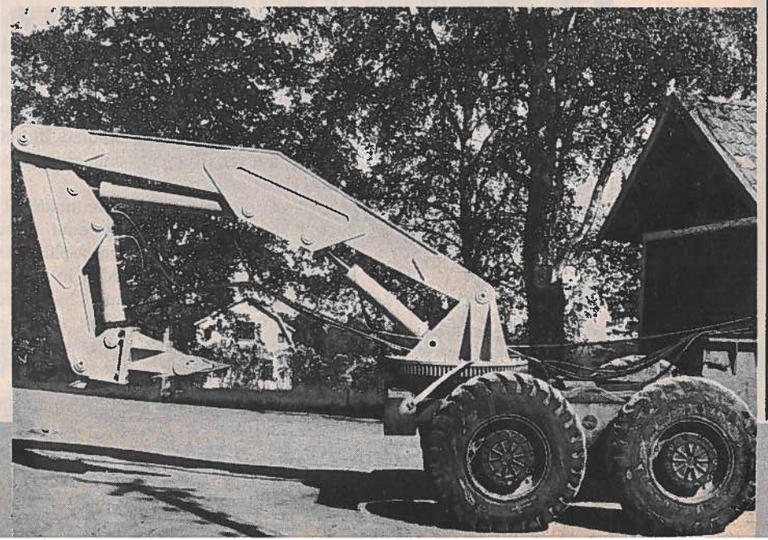
The machine developed by Gruvteknik and Grangärde Plåt och Smide consists of a scaling boom, "Magna 7000," mounted on a rebuilt forestry machine. The boom is turnable and allows both breaking and tearing movements.

The National Board of Occupational Safety and Health has compared the Swedish prototype with an American scaler and states that the former is better both from a technical and safety viewpoint. The driver's cabin is placed far away from the scaling boom, which is an advantage in that it protects the driver from falling material and also reduces vibration. The problem of exhaust fumes from the scaler's diesel has also been solved.

Furthermore, the technical advantages of the Swedish machine mean that it is more stable and the hydraulic details in the boom are protected against falling stones, etc. ■

Gruvteknik
Blötberget 23
S-771 00 Ludvika

Grangärde Plåt & Smide
P.O. Box 4
S-780 13 Grangärde



Safety Equipment for Forestry

☐ Safety equipment and protective clothing are not used to the extent that they should be. One reason for this is that this equipment is often uncomfortable to wear and awkward to work with.

☐ With this in mind, the Logging Research Foundation (Stiftelsen Skogsarbeten) carried out a survey in 1978 of safety clothing and equipment for forestry work on the market.

The object of the survey was partly to encourage the manufacturers to adapt their products to the users' requirements, but also to make it easier for workers, safety committees, buyers and others to choose the most suitable equipment for the man and job in question.

The survey included 10 safety helmets, 22 sets of ear protectors, 18 pairs of safety leggings and 25 pairs of boots.

The views and wishes of more than 2,000 forest workers, safety engineers, industrial physicians, etc., were taken into account in the formulation of the requirements.

Apart from the safety aspects, one of the most important considerations governing the choice of a helmet is that of weight. In forestry in particular, where helmets are used together with ear protectors and goggles, etc., it is essential that helmets be as light as possible.

This is how a well-equipped forest worker should look.

Of the helmets studied only two met the weight restriction of 300 g. Some of the helmets weighed as much as 400 g.

Another important factor is the lining of a helmet. The lining was replaceable in all of the helmets studied. However, in the case of sweatbands—the first component to become soiled and worn out—these were only replaceable in the case of three helmets.

In forestry, where the work is physically exerting, it is desirable that the warm and moist air inside a helmet can be allowed to escape. Several of the helmets were found to have ventilation holes in the top, although the amount of ventilation could not be regulated on any of them.

Since the helmets are often used together with ear protectors and goggles (or visors), it is important that provision has been made for the fitting of such items.

Ear protectors

Of decisive influence to the choice of ear protector is its ability to dampen the noise that exists at the workplace. But it is essential that ear protectors be worn continually when the worker is in a noisy environment. Thus, if ear protectors are to be used properly, it is vital that they be comfortable to wear.

In addition to their importance to the sound-attenuating properties, the height, softness and elasticity of the seal rings on the earpieces are also important from the point of view of comfort. Only two of the pairs of ear protectors studied did not satisfy the requirements concerning softness and elasticity.

All of the seal rings were made of a vinyl sheathing containing foam plastic and/or a fluid. These age rapidly and even after just a few months in use the seal rings have become hard and uncomfortable. It is therefore extremely important that the seal rings and sound-absorbing pads be replaced at regular intervals. "Hygiene kits" containing replacement parts are available for all of the makes of ear protector studied. However, in several cases the seal rings were difficult to replace.

Safety leggings

Since 1975, when the wearing of safety leggings when working with chain saws was made mandatory, the number of accidents of this nature has fallen sharply.

All of the leggings studied satisfied the minimum requirement that they should be strong enough to withstand being cut by a chain with an impact velocity of 12 m/s. The highest recorded value was 18 m/s.

Apart from the legs themselves, it is also important that safety leggings provide adequate protection for the area around the groin.

Safety leggings should be as light as possible. The lightest pair of leggings weighed 710 g and the heaviest 1090 g (type with braces).

Safety boots

Two types of boot were studied, namely, lace-up boots and type wellington boots. The boots are made of rubber, leather or a combination of leather and rubber.

To provide effective protection against crushing, the boots should have a toecap of steel or equivalent material. In addition, the boots should be reinforced to protect the feet from injury caused by the cutting action of a saw chain.

The opinion that many boots currently used in forestry work are far too heavy is widely held. The heaviest are rubber boots, weighing between 1300 and 1400 g per boot, in contrast to lace-up leather boots, which weigh around 800 g per boot. It is generaly true to say that leather boots are lighter than rubber ones. The boot manufacturers are making a concerted effort to bring the weight of safety boots in line with the users' requirements.

Parts of the body that should be protected by safety leggings.

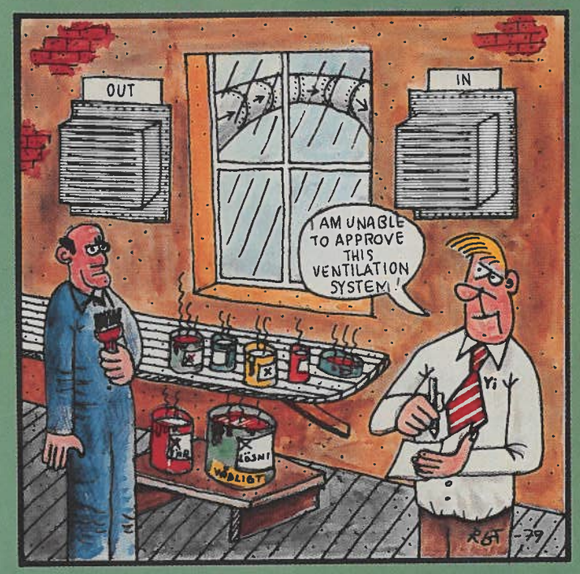
Many accidents in forestry are caused through slipping. It is therefore important that the boots have a self-cleaning, anti-slip tread.

About one half of the boots studied had uppers coated with cellular rubber, rubber or polyurethane. The purpose of this is to make use of the excellent property whereby leather absorbs the moisture that forms inside the boot, yet at the same time provides a totally watertight foot.

To achieve good contact with the ground, the sole of a boot must be able to some degree to adapt to the shape of the surface being walked on. All of the boots were found to have relatively stiff soles, although clear differences could be discerned between the boots studied. ■

Work...

Cleverius – Labor Inspector
Drawing: Bertel Rennerfelt



NEWSLETTER

National Board of Occupational Safety and Health · Arbetarskyddsstyrelsen · Sweden
Mailing address: Fack, S–100 26 Stockholm · Telephone: 46-8-54 02 60 Publisher: Gunilla Warnbeck

No. 2 July 1979

In September, 1979, the Board will move into new premises.

The new address of the Board will be:

**National Board of Occupational Safety and Health,
Arbetarskyddsstyrelsen
S-171 84 SOLNA SWEDEN**

Telephone: 46-8-730 90 00

NEW ISSUES OF "ARBETE OCH HÄLSA"

The Board's scientific series "Arbete och hälsa" contain results of the research carried out within the Board's Occupational Health Department. As a rule the issues *appear in Swedish with a summary in English.*

Summaries contained in the latest issues follow below.

ARBETE OCH HÄLSA 1979: 12

Åsa Kilbom:
Physical work capacity among fire-fighters with special consideration to physical job-demands at smoke-diving.

During smoke-diving fire-fighters perform a strenuous exercise and are exposed to a substantial heat-load. Due to the risk of overexertion it has been suggested that fire-fighters should regularly pass a health-check, including an exercise test and work-ECG. Those who perform smoke-diving should be able to perform exercise for 6 min at 200 W.

417 smoke-divers aged 20–59 from the Stockholm Fire Brigade have participated in work-tests, including ECG, at intensities 100, 150 and 200 W at the Unit of Work Physiology of the Swedish National Board of Occupational Safety and Health.

47 fire-fighters (11 %) could not conclude the work test. 30 of these belonged to the oldest age-group (50–59 years), in which 34 % had to interrupt the test prematurely. The work test was usually discontinued because of physical exhaustion, but in the oldest age-group frequent causes for stopping the test were also ECG-changes, high blood pressure and discomfort from the joints. The calculated maximal oxygen uptake decreased with increasing age.

On the basis of these results as well as previous measurements during smoke-diving recommendations concerning the future control of the physical work capacity in smoke-divers have been formulated. Thus, at the pre-employment test, exercise for 6 min at 250 W on a bicycle ergometer should be required. Work tests including ECGs should be performed each 5th year before the age of 40 and thereafter each 2nd year. The minimum requirements should be conclusion of exercise at 100, 150 and 200 W each for 6 min. Fire-fighters above the age of 50 should not perform smoke-diving. Efficient physical training at least twice a week must be included in the ordinary tasks of a fire-fighter.

ARBETE OCH HÄLSA 1979: 13

Trichloroethylene, Nordic expert group.

Based on a working document, a Scandinavian group of experts has surveyed and critically evaluated the relevant literature for establishing an occupational exposure criterium (TLV value) for trichloroethylene. A recommendation as to which effect or effects should be applied for the basis of the exposure criterium is given.

An up-to-date organization chart of the Board is to be found inside.

ARBETE OCH HÄLSA 1979: 14

Styrene. Nordic expert group.

In this document relevant data are summarized from which valid criteria can be deduced for the development of a recommended standard for styrene. Of the effects described, the following should be taken into consideration in the establishment of a recommended standard: subjective symptoms, chromosomal and CNS effects.

ARBETE OCH HÄLSA 1979: 15

Methylene chloride. Nordic expert group.

Survey of literature on methylene chloride to be used as background for discussion of TLV.

The formation of carbon monoxide is recommended to be used in this discussion.

ARBETE OCH HÄLSA 1979: 16

Birgitta Anshelm Olson, Francesco Gamberale, Bertil Grönqvist and Karin Andersson:
Reaction time changes among steel workers exposed to solvent vapor. A longitudinal study.

A longitudinal study investigated the effect of solvent vapors on central nervous functioning of steel workers (n = 39) who were until 1976 exposed to vapor concentrations clearly exceeding threshold limit values (TLVs). An initial reaction time (RT) test was performed the same year under these exposure conditions. A second RT measurement was made six months following the completion of major improvements in the hygienic quality of the work environment which resulted in a reduction of the exposure levels to 20% of the TLVs valid at the time. Approximately one year after this measurement, a final RT test was performed. The workers' performance on the RT test showed a statistically significant improvement over the three measurements. The improvement was especially marked for one group of workers which had previously been exposed to the highest concentrations. The observed improvement in RT indicates that the workers' central nervous functioning had been negatively affected by solvent exposure and confirms the importance of changes which enhance the hygienic quality of the work environment.

Single copies of the publications of the Board mentioned in this Newsletter are submitted free of charge to foreign addresses on request. See order form.

ARBETE OCH HÄLSA 1979: 17

Birgitta Kolmodin-Hedman, Kurt Erne, Marianne Håkansson and Anita Engqvist:
Occupational exposure to phenoxy acids (2,4-D and 2,4,5-T).

Occupational exposure to phenoxy acids (2,4-D and 2,4,5-T) has been studied in four spraymen spraying 2 per cent emulsion in water in forestry by tractor. The phenoxy acid levels in the breathing zone of the subjects were determined.

The phenoxy acid levels in plasma and urine were determined by electron capture gas chromatography using an internal-standard technique. The air samples were analyzed by UV-spectrophotometry and thin-layer chromatography.

The air levels of phenoxy acids were mostly 0.1 – 0.2 mg/m^3 with occasional higher levels (about 1 mg/m^3) obviously due to contamination of the impinger flash by larger drops.

Plasma and urine levels were followed during a week of exposed work and for 36 hours after exposure. The plasma levels ranged from the detection limit up to 0.1 – 0.2 µg/ml. The levels varied due to intermittent exposure. No rising trend towards the end of the working week was noted. After exposure the levels declined to near to the detection limit overnight.

The highest levels of phenoxy acids were found in urine with a mean of 2,4-D and 2,4,5-T respectively of 8 and 4.5 µg/ml and ranging 3 – 14 µg/ml for 2,4-D and 1 – 11 µg/ml for 2,4,5-T in the afternoon after a day of exposure. In a second investigation the mean 24 hour excretion in urine was 9 mg of 2,4-D and around 1 mg of 2,4,5-T.

The elimination in urine was rapid.

Uptake of phenoxy acids seem both be caused by inhalation and dermal absorption. The experimental conditions did not allow an assessment of the relative importance of the channels of uptake. Improved hygienic conditions are suggested to decrease exposure.

None of the subjects reported clinical symptoms except in one case of slight irritation of the eyes after direct contact with the spray liquid.

In control subjects with a low and indirect exposure no 2,4-D and 2,4,5-T could be detected in plasma or urine. It is concluded that exposure to 2,4-D and 2,4,5-T could best be followed by measurement of the phenoxy acid levels in the urine. The sampling should preferably be made in the afternoon of an exposed working day or within a day following exposure. Lowest detectable concentration in urine of 2,4-D and 2,4,5-T is 0.05 µg/ml.

ARBETE OCH HÄLSA 1979: 18

Anders Kjellberg, Ewa Wigaeus, Jörgen Engström, Irma Åstrand and Elisabeth Ljungquist:
Long-term effects of exposure to styrene in a polyester plant.

Seven male employees exposed to styrene in the processing of polyester boats were studied. The concentration of styrene was measured in the breathing zone continuously during one work-shift. The uptake in the organism was estimated from the concentration of styrene in the inspiratory and alveolar air and the mean pulmonary ventilation. The concentration of styrene in needle biopsy specimens taken from subcutanous adipose tissue after the work-shift was determined by gas chromatography. The amount of body fat was estimated by an anthropometric method. The exposed group and a non-exposed control group performed a reaction time task before and after work-shift. Three persons from each group took part in followup measurements in the afternoon on two occasions during their summer holidays.

The time weighted average concentration of styrene in the inspiratory air was 11–60 mg/m^3 and the total uptake during the work-shift varied between 82 and 357 mg. When cleaning the group was exposed to low concentrations of acetone (19–142 mg/m^3). The concentration of styrene in adipose tissue varied between 3,1 and 13,6 mg/kg. In the exposed group the reaction time was prolonged in the afternoon whereas it was shortened in the control group. The reaction time impairment during work-shift was positively correlated (r = 0.62) with the total uptake of styrene in the organism divided by the estimated amount of adipose tissue. The calculated half-life of the concentration of styrene in adipose tissue after the end of exposure was 4.0, 4.0 and 2.0 days. The exposed group improved their reaction time performance on both follow-up measurements and reached below the initial morning level. The reaction time performance in the control group was, on the other hand, somewhat impaired.

Concentrations of styrene below the Swedish TLV (170 mg/m^3) can presumably cause negative effects on the central nervous system which however seem to be at least partly reversible. Finally, persons with lean body constitution seem to be more susceptible to the acute negative effects of styrene exposure than persons with larger fat deposits.

NATIONAL SWEDISH OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

NATIONAL SWEDISH BOARD OF OCCUPATIONAL SAFETY AND HEALTH

The Board is the central authority for matters concerning occupational safety and health. The Labour Inspectorate comes under the jurisdiction of the Board.

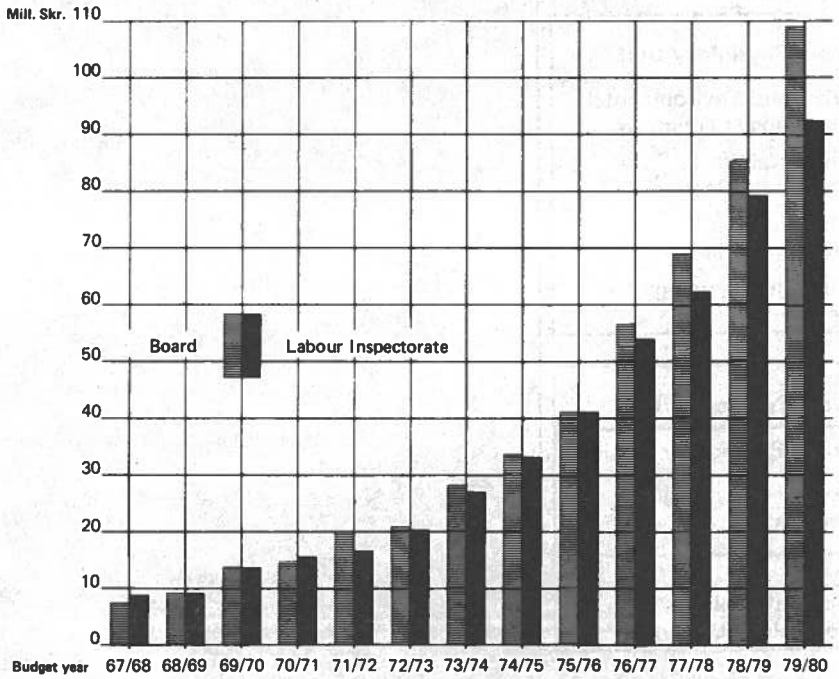
The Board's responsibilities include direction, coordination, and supervision of activities in the occupational safety and health sector. The Board also undertakes research, training, and commissioned activities in the field of occupational health.

The Board is responsible at national level for the enforcement of the Work Environment Act of 1977 and the General Hours of Work Act of 1970 as amended. The Board issues regulations, directions, and notices on the application of this legislation. Within its purview the Board is also responsible at national level for the enforcement of the Act on Products Hazardous to Health and to the Environment of 1973 as amended.

The Directorate of the Board is headed by the Director General, who is also its chairman. The Directorate also includes the Deputy Director General and nine other members, among them representatives of trade unions, and employers' associations, and members of parliament.

The Board has three main departments: the Supervision Department, the Occupational Health Department, and the Administrative Department (see organization chart overleaf). The Occupational Health Department was set up in 1972 when the former National Institute of Occupational Health, Arbetsmedicinska Institutet, was incorporated into the Board.

ALLOCATIONS GRANTED TO THE BOARD AND TO THE LABOUR INSPECTORATE



The allocations granted to the Board and the Labour Inspectorate for the fiscal year 1979/80 amount to Skr 203 million or US $ 46.4 million. Of this sum Skr 109. million is intended for the Board and Skr 94 million for the Labour Inspectorate. In comparison with the fiscal year 1978/79 this is an increase of Skr 38.3 million (US $ 8.8 million). (See chart on this page).

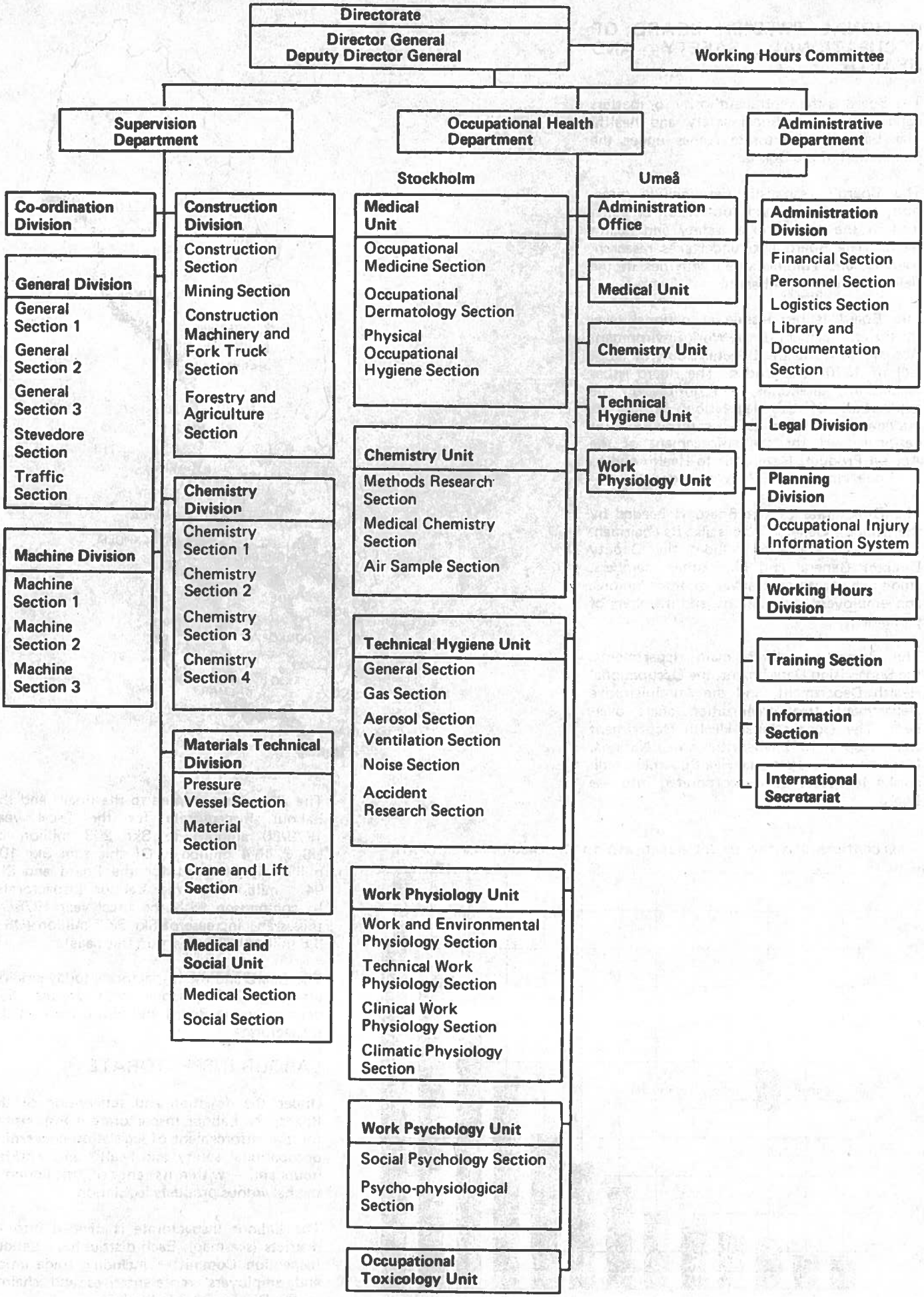
The Board and the Inspectorate today employ around 1 200 persons with around 650 persons at the Board and 550 persons at the Inspectorate.

LABOUR INSPECTORATE

Under the direction and supervision of the Board, the Labour Inspectorate is responsible for the enforcement of legislation concerning occupational safety and health and working hours and – within its range of jurisdiction – the hazardous products legislation.

The Labour Inspectorate is divided into 19 districts (see map). Each district has a Labour Inspection Committee including trade union and employers' representatives and chaired by the District Superintendent.

NATIONAL BOARD OF OCCUPATIONAL SAFETY AND HEALTH



ARBETE OCH HÄLSA 1979: 19

Martin Friberg:
An ergonomic comparison of two library carts.

This study describes an ergonomic comparison of two library cart types, an older model (wooden cart) and a newer model (Plexal II), which are used in hospital libraries. The required handling forces and ergonomic considerations in ordinary transport and manoeuvring situations were investigated.

Handling forces within the same handling situation were 10 to 60 N larger for the Plexal II cart than for the wooden cart except in one case where the forces were identical. The largest difference in the required manoeuvring force was measured for crossing a 20 – 25 mm high threshold.

The measured forces for those work situations studied varied between 20 and 330 N for the wooden cart and between 30 and 380 N for the Plexal II cart.

It is suggested that motordriven library carts be used to reduce the required force for hospital library cart operators with back or joint problems. Such carts are currently in use at one hospital in Enköping. Other suggestions for ergonomic improvements are also given.

ARBETE OCH HÄLSA 1979: 20

Ingvar Holmér, Sture Elnäs, Björn Sköldström and Gustaf Kihlström: Heat stress during dives in warm water.

The thermal strain was studied in two divers during 60 min dives in water at 34, 38 and 42° C. The purpose was to provide some guide-lines for the assessment of tolerable exposures to dives in fuel basins in nuclear power plants. The divers performed a light work on a bicycle ergometer alternating with periods of rest. The divers wore underwear and a rubber diving suit. The cooling effect of wearing an ice vest underneath the suit was evaluated in the same series of experiments. The thermal strain increased with increasing temperature of the water. In water at 42°C body and mean skin temperature were higher than 39.0°C, subjects felt the conditions intolerable and exposure was interrupted after 30–45 min. The ice vest significantly reduced the thermal strain, resulting in less increase in body and mean skin temperature with exposure. The rate of body heat storage was consistently lower with ice vest, but rose generally with increasing water temperature. The heat stress during dives in warm water necessitates the assessment of limited exposure times. The cooling power of an ice vest makes possible to double the exposure time in water temperatures at 35–45°C.

Change of address:

Write to

International Secretariat,

Arbetarskyddsstyrelsen,

National Board of

Occupational Safety

and Health,

S- 17 184 Solna

Sweden

No. 2 July 1979

Please note that, if not otherwise indicated the publications exist in Swedish only.

ORDER FORM

To be sent to

National Board of Occupational Safety and Health
Arbetarskyddsstyrelsen
Publication Service
S-171 84 SOLNA, SWEDEN

Please send me the following material:

Pamphlet about the National Occupational Safety and Health Administration

☐ in English ☐ in French ☐ in German

☐ in Finnish ☐ in Swedish

☐ Ordinance No .....

☐ Arbete och Hälsa No .....

☐ Investigation Report No .....

☐ Training Report No .....

☐ Catalogue of research projects 1977. In English .....

☐ Work Environment Act and Work Environment Ordinance. In English .....

General Machine Directions No. 29. Price: Skr 50 (excluding service charge).

☐ in English ☐ in German

☐ Investigation Report 1979: 19 on chemicals in the rubber industry. In English. Price: Skr 50 (excluding service charge).

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NEWSLETTER

National Board of Occupational Safety and Health · Arbetarskyddsstyrelsen · Sweden
Mailing address: Fack, S–100 26 Stockholm · Telephone: 46-8-54 02 60 Publisher: Gunilla Warnbeck

No. 2 August 1978

THE BOARD'S BUDGET PROPOSALS FOR THE FISCAL YEAR 1979/80

The allocations granted to the National Board of Occupational Safety and Health and the Labour Inspectorate for the fiscal year 1978/79 amounted to Skr 165 million.

In the budget proposals for the fiscal year 1979/80 the Board demands an increase of Skr 81 million and 181 new posts, i.e. a total budget of close to Skr 246 million or U.S. $ 55.2 million (in the monetary value of September, -78).

Of the requested budget increase of Skr 81 million a sum of Skr 56 million is intended for the Board and the remaining Skr 25 million for the Labour Inspectorate. Of the 181 new posts requested 106 are meant for the Board and 75 for the Labour Inspectorate.

NEW DIRECTIONS OF THE BOARD

Organic solvents

The **Directions No. 124, Organic Solvents,** issued by the Board enter into force on 1st October 1978. These directions contain general and overriding rules concerning the prevention of fire, explosion, poisoning, annoyance etc. during work involving the use of solvents and products partly containing solvents, e.g. glue and paint. On the other hand the directions do not include such matters as the handling of petrol for the operation of motors and engines and the transportation of solvents generally.

The directions emphasize the importance of both technical and organizational measures, together with product selection and information, with reference to minimizing the total risks entailed by work using solvents.

Among other things the directions provide that the exposure of workers to solvents must be restricted to the greatest possible extent. It is the duty of the employer to make certain that improperly heavy exposures do not occur.

The directions also include a number of new rules aimed at reducing fire hazards. These rules refer mainly to work in confined spaces.

The directions also make it the duty of the employer to supply the foremen and other employees concerned with information and training regarding all risks attaching to work using solvents and regarding means of avoiding such risks. Work instructions, the labelling of solvent containers and the display of notices at work places are among the means whereby this is to be accomplished.

Rock inspection, scaling and rock reinforcement

The **Directions No. 125** concerning **Rock inspection, scaling and rock reinforcement** have been issued by the Board and enter into force on 1st January, 1979. These directions have been occasioned by the occurrence in recent years of fatal accidents in connection with scaling and rock reinforcement.

Planning
The directions include stipulations concerning site inspections before and after the commencement of operations. An inspection from the ground surface (prior inspection) is to be undertaken at the earliest possible stage in order to arrive at the most reliable assessment possible of the rock in which a space is planned so that suitable methods for driving the rock space can be selected at the planning and design stage. While driving operations are in progress, the rock face must be inspected (operational inspection) to avoid dangerous surprises.

Personnel
At any work site where rock work is being done, the employer must appoint at least one scaler to be responsible for the area.

The scaler reponsible for an area must have attended rock reinforcement courses and must have had at least two years' experience of the type of rock work involved.

A person who has not attended a course but who has had at least four years' experience may also be appointed scaler in charge of an area.

Any other scaler carrying out scaling operations involving the use of explosives must have had at least one year's experience.

Cordoning off
During blasting operations, any dangerous area on a blasting site must be kept closed to unauthorized persons until it has been made safe.

In connection with blasting operations, an assessment must be made of the possibility of falls of stone or land slips being caused outside the blasting site. Any such external area must also be cordoned off while blasting is in progress.

An area must also be cordoned off if any other circumstance than blasting, e. g. ground vibrations or rock pressure, is judged liable to cause damage of injury through falling stones and land slip.

Making safe - protective roof
Swedish rock is usually of good quality, but the rock in walls and roofs has to be inspected and tested (rock inspection). Any loose stones or areas of rock that are discovered must be broken down (scaling) or secured by various methods (rock reinforcement). All operations involve a serious risk of accidents unless they are conducted from a sheltered position. The term "sheltered position" refers to a place

under a protective roof or shielded by some form of propping.

Chemical pesticides

The **Directions No. 126 Chemical pesticides** issued by the Board enter into force on 1st March 1979. These directions refer to the handling of chemical pesticides, above all in forestry, agriculture and horticulture.

The directions stipulate that such work is to be planned and supervised and conducted using techniques affording adequate security against ill health or accidents. Employees must be trained and instructed concerning working methods, safety regulations, matters of hygiene and the testing and care of personal safety equipment. Safety regulations on the packages containing pesticides must be studied and complied with.

Warning signs must be put up when pesticides are used indoors or in greenhouses.

If an employee develops symptoms which suggest poisoning, work is to be discontinued immediately and a doctor contacted. The causes of the poisoning are to be investigated and the requisite measures taken.

Pesticides must be sprayed in such a way as to avoid exposure. Outdoor spraying should not be undertaken when there is a strong wind blowing.

Seed disinfectant machinery must be fitted with an extraction device connected to a particle separator. Premises used for the storage of disinfected seed must be well ventilated. Packaging used for disinfected seed must be marked. Pesticides must be stored out of reach of children and unauthorized persons and should be kept under lock and key.

Pesticide packages in transit in forestry and agricultural property must be secured to the vehicle. Pesticides must not be left unguarded after they have been unloaded.

A packaging should not weigh more than 35 kg, and it should be provided with air holes so as to avoid splashing when it is emptied.

The requisite personal safety equipment must be provided and used during all work which is liable to entail exposure. The equipment must be cleaned after use and should be kept in a special place. If special conditions preclude the use of personal safety equipment, the work may not be done.

Soap and water must be available during work involving the use of pesticides. Proper hygiene must be observed. Food, drink, tobacco etc. may not be kept in such a way that they are liable to be contaminated by pesticides.

For certain kinds of work, two changing rooms must be provided - one for working clothes and the other for walking out clothes. There must be a wash room between these two changing rooms.

Epoxy products

The **Directions No. 127, Epoxy Products,** issued by the Board enter into force on 1st October 1978, except for certain points which do not take effect until 1st April 1979. These directions refer primarily to work on temporary sites. The information they contain concerning rules will also be used, where relevant, as a basis for the definition of rules governing permanent work sites.

The directions impose limitations on the commercial handling of epoxy products. They stipulate that an epoxy product may only be used if experience has shown that a product less hazardous to health does not function satisfactorily. If an epoxy product has to be used, it is important to select the products which are least hazardous to health. If a certain epoxy product can be shown to represent a greatly reduced health hazard, the Board may consent to less rigorous measures being taken.

The directions contain rules concerning safety precautions for work using epoxy products, e.g. rules concerning work place design, personnel facilities, personal safety equipment and personal hygiene.

Other important rules concern training and information and the labelling of products.

Special training in occupational hygiene, focussing above all on the prevention of health hazards associated with epoxy resin and hardening agents, is to be given to employees who will be using epoxy products on a temporary work site. After 1st April 1979, no employee will be allowed to work with an epoxy product without having received prior training of this kind. Foremen and safety delegates are also to receive information and training concerning safety precautions in connection with work involving the use of epoxy products.

Packaging and other containers holding epoxy products must, when handled at a work site, be labelled to show that the product is of an epoxy type and also to show the manner in which it is liable to endanger health - for example, that it is a skin allergen.

Certain epoxy products must also be labelled as provided in the Act on Products Dangerous to Health and the Environment, i.e. while they are still at the distribution stage.

Conveyors

The **Directions No. 128 Conveyors,** from the Board are based on Swedish standard and include all types of conveyor except for fully enclosed hydraulic or pneumatic conveyors with gauge pressure or underpressure, funiculars and devices for the conveyance of passengers. The directions come into force on 1st January 1979.

These directions are concerned with design, use and current inspection. They deal particularly with belt conveyors and bucket elevators, together with their enclosure and other safety features.

The general rule stated in the directions is that the constituent materials, design and equipment of all types of conveyor must be such as to afford adequate security against accidents and ill health in the operating conditions for which conveyors are intended and that conveyors of all types must be fitted with the requisite safety devices.
Current inspection as referred to in these directions includes maintenance measures such as lubrication, adjustment and cleaning. The directions specify accident prevention measures to be taken in the course of current inspection.

Aerial passenger lifts

The Board's **Directions No 129, Aerial Passenger Lifts** have now been published and enter into force 1st January 1979. This Direction supersedes Directions No 37 concerning construction, inspection etc of monocable aerial lifts for transportation of passengers.

Directions No 129 establish safety regulations and standards for monocable aerial lifts, like gondola lifts and chair lifts. The regulations concerning tests and inspections are also valid for bicable lifts.

Besides the various safety problems connected with the design and construction of the lift and the stations for embarkation and disembarkation, the direction also contains rules concerning the location, maintenance and operating of the lift and also regulations concerning the rescue organisation that shall be available.

Aerial passenger lifts are subject to official testing and inspection which shall be performed by AB Statens Anläggningsprovning (The Swedish Plant Inspectorate).

Low lifting platform lifts

Directions No 130 issued by the Board concerning **Low Lifting Platform Lifts intended for transportation of passengers in wheel chairs** enter into force 1st July, 1979.

The directions cover design construction, installation operation, maintenance testing and inspection of such platform lifts.

The lifts are classified into two main classes:

Class A: Lifts installed in an enclosed hoistway.
Class B: Lifts not operating in an enclosed hoistway.
The maximum travel for class A lifts is 4 m and for class B lifts 2,5 m.

The lifts are subject to official testing and inspection that shall be carried out by AB Statens Anläggningsprovning. (The Swedish Plant Inspectorate).

Crane lifts

In February 1975 the Board issued directions No. 103, Building Crane Cabs, concerning the construction and design etc. of crane drivers' cabs. These directions state that the crane must be equipped with a mechanically driven lifting platform (a crane lift) when the cab is a certain height above ground.

The Board has now issued **Directions No. 131** concerning the design, current maintenance and inspection of **Crane lifts for building cranes.** These directions refer to vertically moving platforms or crane cabs. The directions enter into force on 1st January 1980.

The directions contain detailed provisions concerning the design of such lifting members as hawsers, sheaves, racks and pinions, rules concerning arresting devices, speed restrictors, hawser tensioners and safety devices. The directions provide that current maintenance and inspection are to be carried out in compliance with the building crane regulations contained in the Board's Directions No. 58, except that periodic inspections of crane lifts may be carried out at intervals of 12 months.

Fly facilities of theatres

The Board has issued directions concerning **Fly facilities** used in theatres, public halls and comparable premises **(Directions No. 132).**

Fly facilities are used for suspending loads – which may, for example, consist of scenery and weigh more than 100 kg – above the artists appearing on the stage.

The directions lay down clear rules concerning the way in which fly facilities are to be designed and concerning the inspection procedure to be followed in order for work in the vicinity of fly facilities to be made safer.

The directions enter into force on 1st October 1980. They contain provisions concerning the official testing of fly facilities. Testing is to be conducted by AB Statens Anläggningsprovning (the Swedish Plant Inspectorate) and will imply the subjection of fly facilities to primary inspection. Power driven and counterweight balanced fly facilities are also to be subjected to revisal inspections at certain regular intervals.

Car lifts

From 1st January 1980 new Directions for car lifts enter into force. The new **Directions No. 133, Car lifts,** replace the earlier regulations for car lifts that were part of Directions No. 107.

The new directions are quite complete and deal with all kinds of car lifts except for so-called low lifts having a lifting height of 0.5 m or less.

Special care has been taken to make the area underneath and close to the car lift a safe working area.

This has been achieved partly by stipulating various automatic safety devices and also by stipulating minimum distances between moving parts of the car lift and walls, pillars, floor, platforms etc.

Car lifts are subject to official testing and inspection. Testing and inspection are carried out as type approval and/or individual inspection of each car lift, with annual inspections thereafter. The testing and inspection of car lifts shall be performed by AB Statens Anläggningsprovning (The Swedish Plant Inspectorate), which has been responsible since 1st of January 1977 for all official testing and inspection of lifting devices.

The directions also apply to existing installations, with certain specified exemptions.

Stacking cranes

The Board has issued directions concerning work with **Stacking cranes (Directions No. 134).** These directions are a codification of stipulations concerning the way in which stacking cranes must be designed and proportioned in order to ensure a safe work place and a good work environment. In addition to various rules concerning mechanical strength and stability, the directions include rules concerning clearances and evacuation routes. Moreover, the directions lay down that the working area of the stacking crane must be enclosed in order to prevent unauthorized persons from gaining access.

The directions apply to all types of stacking cranes and their appurtenant transfer trucks, and they also apply to trucks which are designed and used in a similar way to stacking cranes. Brief instructions are given for the guidance of drivers, who should have attended a special drivers' course comprising both theoretical studies and driving practice.

The directions enter into force for the most part on 1st January 1979. They also stipulate official testing by the Swedish Plant Inspectorate, the rule being that a stacking crane must be inspected before it is commissioned and that it must be subjected to annual revisal inspections.

Vinyl chloride

Directions No 135 for the prevention of health hazards due to **Vinyl chloride** have been compiled by the Board and entered into force on 1st August 1978.

Vinyl chloride is an inflammable gas which condenses under pressure to form a liquid. It is used in the manufacture of polyvinyl chloride (PVC), which is a common plastic.

Vinyl chloride is carcinogenic and has given rise to a number of cases of angiosarcoma, which is a rare type of liver tumour. Vinyl chloride is now classified as a poison.

It has now been made compulsory for atmospheric vinyl content in connection with the production of vinyl chloride to be measured twice annually. Measurements must also be taken in PVC processing industry using a raw material whose residual vinyl chloride content exceeds 10 mg/kg PVC. If the measurements thus obtained are satisfactory, i.e. less than half the hygienic limit value, no control measurement is necessary. The hygienic limit value for vinyl chloride is 1 ppm.

The new directions stipulate that warnings must be put up in places where vinyl chloride content is liable to exceed the limit value. Containers used for storing vinyl chloride must be labelled with a poison warning. PVC manufacturing must if possible be conducted in such a way that workers do not need to descend into autoclaves. PVC must be given the lowest possible vinyl chloride content by means of vacuum degassing.

The workers involved must be informed of the hazards associated with vinyl chloride and of the safety precautions to be taken. Instructions for the measurement of atmospheric vinyl chloride content are given in a special appendix.

Please note that all the directions mentioned in this issue are published in Swedish only.

Reading of display screens

The **Board's Directions No. 136, Reading of display screens,** enter into force on 1st January, 1979. The following is a word - for - word translation of the directions.

1. General lighting must be suitably adapted. Special importance must be attached to lighting conditions at work places where reading of display screens occurs regularly. Generally the lighting required is weaker than that often used in ordinary office work. In work places where work is continously conducted at display screens, a lighting power of between 200 and 300 lux may be suitable.

Note: Lower lighting power levels may be appropriate in certain working environments of a special nature (e.g. monitoring and traffic control).

2. When general lighting is subdued as per point 1, additional lighting must be provided for other working areas near the display screen. Additional lighting must be adjustable and fitted with anti-dazzle arrangements.

3. Excessive differences of luminance in the field of vision produce what is termed contrast dazzle. The work place should therefore be organized in such a way that the background to the display screen is of a suitable luminance and the employee's field of vision does not include a window or any other powerful light source. Bright reflections in the display screen are to be avoided.

4. The visual distance to the display screen and the angle of inclination of the display screen should be individually adjustable with due regard for other ergonomic requirements. In the case of employees who wear glasses, it is important that the optical correction is well adapted to the visual distance, and vice versa.

Note: Ordinary glasses for private use are often unadapted to the visual distances occurring in display screen work. Traditional bifocal spectacles are unsuitable in many cases, because they often entail a strenuous work posture when used for display screen reading.

5. If an employee has a refractive error and incurs visual discomfort in connection with display screen work when using glasses intended for normal purposes, the display screen must be moved to a position where the discomfort is eliminated. If this is not possible, the employer is to provide the employee with special glasses which have been tested for display screen work.

6. If eye fatique or visual discomfort tends to develop, the work must be organized in such a way that the employee can intermittently be given periods of rest or work involving more conventional visual requirements.

Antifouling paint

The Board has issued additional **Directions** in the series entitled Shipyard Directions. This latest addition is called **Antifouling Paint** and is number **19: 8** in the series.

The main part of the Directions come into force on 1st January 1979, and some parts enter into force on 1st January 1980.

The hulls of ships are coated with antifouling paint to prevent them becoming encrusted with algae and other marine organisms. This paint contains growth-inhibiting substances which can be dangerous to inhale, may irritate the skin and may cause inflammation if they get into the eyes. Certain substances sometimes included in antifouling paints may be allergenic. The Directions provide that copper, copper oxide and zinc oxide may be used in antifouling paint, as may certain organic tin compounds, but that they may not exceed the levels indicated.

When antifouling paint is being applied, an enclosed risk zone must be established and reserved for those employed in the painting operations. In addition, safety regulations must be posted at suitable points.

The Directions also deal with the waste resulting from painting, with the cleaning of surfaces to which antifouling paint has been applied and with the removal of paint. Washing facilities must be provided in the immediate vicinity of work sites, in view of the great importance of proper hygiene in connection with work of this kind. The employer must provide the various kinds of personal safety required for the conduct of the work.

General Machinery

The Board's **Directions No 29, General Machinery,** deal with safety precautions common to stationary, portable and mobile machinery, machine tools, vehicles and implements. The measures indicated by the directions may be carried out in other ways, provided the corresponding degree of safety is achieved. If special directions have been issued for a particular machine, those directions are to apply instead in the event of their differing from the General Machinery Directions.

Among other things the directions indicate suitable guards for dangerous machine movements, the design of safety devices, demands which can be made concerning control devices and safeguards against the unauthorized starting of machine. Noise, dust and other impurities are also dealt with, as are lighting, the colouring of machinery and other ergonomic considerations.

The directions enter into force on 1st January 1980 for machinery delivered or commissioned as from that date. In the case of machinery delivered before 1st January 1980, efforts must be made to secure and adjustment to the directions.

Safety nets

The Board has issued **Directions No 32: 2, Safety nets.** The directions enter into force on 1st January 1979.

Because safety netting has become increasingly common in recent years in the building and shipbuilding industries as a supplement to safety rails and to safety belts and lines for work at great heights, the Board has issued rules concerning the design and use of such netting.

The directions stipulate that all netting intended to catch falling persons or objects must be of a design which has been tested and approved. Specifications are made concerning the construction of netting, e.g. maximum permissible mesh, stabilization against ultraviolet light and the strength of the edge line and erection lines.

The strength of netting is to be checked at least once half-yearly by performing a tensile test on one of the rest wires which must be permanently incorporated in the netting when delivered. Netting which is in use must be inspected once weekly and after any near accident.

In order for nets to function properly it is essential that they be fitted properly, in the right place and in constructions capable of absorbing the forces transmitted from the nets when somebody falls into them. These matters are dealt with in detail in Chapter 6 of the directions.

Netting must be marked with particulars concerning the manufacturer/importer, the month and year of manufacture, the size of the netting, the maximum drop for which the netting is approved, and the minimum clearance required underneath the netting.

Each net must be accompanied by erection, maintenance and safety instructions which include particulars concerning the materials of which the netting is made and the resistance of the netting to chemicals and gases etc.

The stipulations made in the directions have been evolved after extensive testing of different makes of netting by the National Swedish Institute for Material Testing. The drop tests were for the most part conducted in accordance with British Standard BS 3913.

Saws

In March 1978 the Board issued **Directions No 51: 3 Saws,** belonging to a series of directions for woodworking machines. When entering into force on 1st January 1980 these directions supersede certain parts of older directions No 51, issued in 1963.

The directions are divided into six chapters:

- General rules, applicable to all types of saw
- Frame saws
- Band saws
- Rip saws
- Crosscut saws
- Circular saws for ripping, cross-cutting and panel sawing.

The main features of the directions are the following.

Sawing tools shall be guarded to prevent unintentional access to dangerous parts. In principle any not working part of a saw blade shall be completely enclosed, if possible within the structure of the machine. For the working part there shall be an adjustable, rigid guard. If required for service or maintenance purposes a guard should be hinged in such a way that complete removal is not necessary. The operator is obliged to see that guards are properly adjusted.

Any saw should be arranged to prevent work pieces, splinters etc from being thrown away and so that kick-back does not or cannot cause injury. Reference is made to riving knife, anti-kick-back devices etc.

For the riving knife, when prescribed, specifications are given concerning material, dimensions, stability, installation etc. The operator is obliged to see that the knife is adequately adjusted.

Detailed prescriptions for marking of circular saw blades and spindles are given.

For the several types of saw particular emphasis is laid upon arrangements and working methods eliminating the need of working close to moving parts.

Premises

The Board has issued a revised version of **Directions No 88** concerning **Premises.** The directions enter into force on 1st January, 1979.

In many cases these Directions refer to the Swedish Building Standards (SBN). The publication of a revised version of the standards, SBN 75, called for a corresponding revision of the Boards's directions concerning premises.

As previously, the directions deal with general aspects of working premises, e.g. headroom and ventilation, communication facilities, e.g. gangways, transport routes, evacuation routes and loading bays. They also refer to safety constructions such as safety rails and to certain lifting and conveyor devices and facilities for gas, refrigeration, electrical power etc.

The new directions imply an intensification of the rules applying to ventilation, and they include new stipulations concerning maintenance and cleaning.

In certain cases the directions refer to a particular point in SBN. In cases of this kind, the SBN rule thus referred to ranks as a direction under the Workers' Protection Act. In other cases the directions only make general reference to SBN, e.g. "cf SBN" or "see SBN". A reference of this kind merely serves to point out that SBN also contains rules in the subject in question.

Limit values

In October 1974 the Board issued **Directions No, 100** concerning **Limit values for air contaminants at places of work.** These directions came into force in January 1975 and remain valid up to and including 31st December 1978. In May 1978 the Board issued **Revised directions** under the same title. These revised directions come into force on 1st Januari 1979.

The new limit value list comprises about 190 substances (values) as against the 120 or so in the earlier schedule. Several additions and alterations have been made. About 36 limit values have been lowered, including those for benzene, ethylene oxide, formaldehyde, cobalt, carbon tetrachloride, chloroform, cristalline silica, methylene chloride, oil mist, styrene, tetrachloroethene, toluene, methyl chloroform, tri-chloro-ethene tetrachloroethylene, trichloroethylene, and xylene. New limit values have been added for about 70 substances or groups of substances, including acrylonitrile, benzo(a)pyrene, thermoset dust, wood dust, n-hexane, chromium (III), 2-nitropropane, tin organic compounds and halothane. The schedule now lists about 70 solvents as against 39 previously, and 15 of the limit values for this category have now been lowered. Carcinogens—apart from those which have been given limit values — have been grouped into two separate lists. Group A comprises 12 substances which may not be used occupationally (as against 6 previously). Group B includes 28 substances which may only be used after the Labour Inspectorate has issued special instructions concerning their handling at each individual work place (as against 19 previously). Some substances have been transferred from Group B to Group A. The number of carcinogens with limit values in the new schedule is 19 as against 12 previously. These substances have also been grouped in a separate list, C.

Other directions published by the Board since the previous issue of Newsletter.

The Board has issued **Directions No 12: 2 Electrostatic powder spraying.** The directions enter into force on 1st July, 1979

Notice No 1978: 12 Amendment to the Board's Directions No 3, Blasting operations

Notice No 1978: 13 Rock drill for drifting and tunnelling

Notice No 1978: 14 Amendment to the Board's Directions No 67, concerning underground work in mines, quarries and construction

Notice No 1978: 15 Amendment to the Board's Directions No 23, concerning staff rooms

Notice No 1978: 17 Pre-school (nursery school) and after-school centres

Notice No 1978: 18 Medical examination and medical inspection to prevent pneumoconiosis

Notice No 1978: 19 Erection of structural steelwork

Notice No 1978: 20 Erection of prefabricated concrete panels

Notice No 1978: 21 Pressure and tightness testing of pressure vessels and pipings

Notice No 1978: 22 Tool equipment for work with power presses

Notice No 1978: 23 Intercommunication with passenger mine kibbles in mine lifts

Notice No 1978: 24 Charging etc of lead accumulators (batteries) of battery-operated cleaning machines, trucks etc.

Notice No 1978: 25 Postponed entry into force of the Board's Directions No 85, Combine harvesters

Notice No 1978: 26 Amendment to the Board's Building Directions No 32

Notice No 1978: 27 Primary inspection of cisterns according to the Cistern Code VIII issued by the Pressure Vessel Commission.

Notice No 1978: 28 Amendment to the Board's Directions No 117, Sewer Systems

Notice No 1978: 29 Structural steelwork for cranes. Material, construction design etc.

Notice No 1978: 30 Calculation of steel-wire for machinery in work with cranes etc.

Notices No 1978: 31 Stability of cranes

Notice No 1978: 32 Structural steelwork for cranes. Dimensioning and welding control

Notice No 1978: 33 Asphalt spreading

Notice No 1978: 34 Amendment to the Board's Notice No 1977: 8, Installation of certain plastic tube systems at temporary working sites

Notice No 1978: 35 Application of the Water Heater Code issued by the Pressure Vessel Commission

Notice No 1978: 36 Demolition of construction containing asbestos or material containing asbestos

Notice No 1978: 37 Application of the Piping Code issued by the Pressure Vessel Commission

Notice No 1978: 38 Work with petroleum base industrial oils

ORDINANCE ISSUED BY THE BOARD

Minors at work

Persuant to the section 18 of the new Work Environment Ordinance an ordinance has been issued by the Board concerning the employment of minors. Excerpts of the main rules follow below.

General rules concerning the employment of minors

Section 5
A minor must have received the training and instruction required for his safety at work, due consideration being had concerning his age.

Section 6
The work must be led and supervised by a responsible person who has been instructed concerning his responsibilities.

Section 7
A safety delegate must be notified as to where a minor is employed and also concerning the nature of his duties.

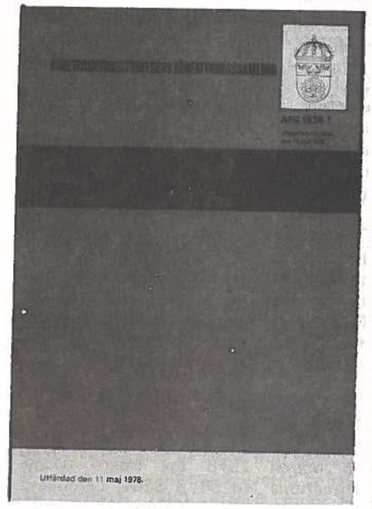
Section 8
A minor may not be employed on work below ground in a mine, quarry or any comparable work place unless the work is done exclusively in a completed space which is safeguarded against falls of stone. This restriction shall not apply, however, to a minor who is undergoing or has undergone upper secondary school training for such work, if a medical certificate shows that there are no medical objections to his being thus employed.

Special rules concerning certain age groups

Section 9
Before the calendar year of this thirteenth birthday, a minor may only be employed on isolated occasions and for up to five consecutive days.

Section 10
Before the calendar year of his sixteenth birthday, a minor may not be employed without the knowledge of his parent or guardian. The work shall be done between the hours of 6.00 and 19.00, on a school holiday or after school is ended for the day. The minor is to be free from work on a school holiday in the week, at the weekend if possible.
Work done during leave of absence from school exceeding five days may not comprise more than eight hours of the day and forty hours per week, overtime included. Other work, overtime included, done during the school term may comprise up to seven hours of the day and twelve hours per week, Work of the latter kind is subject to the consent of the school management.

Section 11
The provisions of Section 10 shall apply, mutatis mutandis, to a minor who has not completed his compulsory schooling. Exemption under the Education Act from participation in ordinary school work is equated with the completion of compulsory schooling.



Exceptions

Section 12
If there are special grounds for so doing, the Labour Inspectorate may waive the provisions of Section 8 for a certain minor or task, and it may similarly waive the provisions of Sections 9-11 for a certain minor.

Section 13
Application for an exception is to be made by the employer in writing to the Labour Inspectorate in the district where the work place is situated. If the consent of the school management is required, a certificate of such consent is to be appended to the application. As a condition for the granting of an exception, the Labour Inspectorate may stipulate that the minor is to undergo a medical examination.

NEW ISSUES OF "ARBETE OCH HÄLSA"

The Board's scientific series "Arbete och hälsa" contain results of the research carried out within the Board's Occupational Health Department. As a rule the issues *appear in Swedish with a summary in English.*

Summaries of the latest issues follow below.

Arbete och Hälsa 1978: 5

Åsa Kilbom:
Lung function and working capacity in patients with silicosis and in control subjects exposed to silica-dust.

Spirometry, gas exchange studies and measurements of working capacity were performed in 21 patients with silicosis (X-ray stage I and II) and in a control group consisting of 25 men with a similar exposure to silica-containing dust. All were 46 to 64 years old and occupationally active in heavy or relatively heavy work as drillers and blasters in construction work or as foundry workers.

The maximal oxygen uptake was significantly lower in the patient group than in the control group (2.57 and 2.79 1/min respectively). Moreover, the control group had a somewhat higher value than comparable groups of Swedish men. Both at rest and during work the patients had a higher respiratory frequency than the controls, and the patients also had a relative hyperventilation, caused by an increased dead space-ventilation.

The gas exchange studies showed significant differences between patient and control groups both in arterial oxygen tension and alveolo-arterial oxygen difference.

An analysis of the individual results demonstrated that many patients, but also several subjects in the control group had an arterial oxygen tension below and an alveolo-arterial difference above normal values especially during heavy exercise, as a sign of a disturbance of ventilation-perfusion and/or diffusion within the lungs. The relative dead space-ventilation (V_D/V_T quotient) and the arterial oxygen tension during heavy exercise were the measures which best discriminated between patients and control subjects, whereas spirometry gave a very low number of pathological results.

In conclusion, both working capacity and lung function were affected in a group of patients with silicosis at an early stage.

This effect was clearly demonstrated during heavy bicycle exercise but is also estimated to effect the ability to perform occupational work demanding physical activity.

In the control group several subjects showed signs of a disturbed gas exchange during heavy exercise, and this can probably be ascribed to the long-lasting dust exposure.

Arbete och Hälsa 1978: 5

Åsa Kilbom, Olof Vesterberg and Alf Askergren:
Smoking habits and alfa-1-antitrypsin in serum in patients with silicosis and in control subjects.

19 patients with silicosis and 46 healthy subjects were examined with respect to smoking habits and concentration of alfa-1-antitrypsin in serum. Both groups had been exposed to silica-containing dust while rock drilling and blasting in construction work for an equally long time (on the average 34 and 31 years respectively). In the control group cigarette smoking was somewhat more common than in the patient group, but the difference between groups was not statistically significant. The patients had a significantly lower concentration of alfa-1-antitrypsin than the controls (246 ± 16 and 279 ± 10 mg/100 ml respectively), but no cases of very low concentration of alfa-1-antitrypsin occurred in either group. Therefore no great importance can be attached to alfa-1-antitrypsin deficiency as a risk factor for the development of silicosis. Probably one or several hitherto unknown risk factors exist which, possibly in combination with a relative alfa-1-antitrypsin deficiency, increase the risk for the development of silicosis after exposure to silica-containing dust.

Arbete och Hälsa 1978: 6

Ulf Ulfvarson, Ulf Hallne, Tom Bellander, Hans Hayenhjelm, Bengt Sjögren and Åke Swensson:
Work environment problems in welding. 4. Gas shielded welding in aluminium alloys.

The purpose of the present investigation was to measure the type and magnitude of air contamination emitted during gas shielded welding of aluminium and aluminium alloys. The work places included in this study are highly representative of those where this type of weldings is practised. The number of persons engaged in MIG and/or TIG welding with aluminium and aluminium alloys in Sweden is approximately 200. Altogether 102 welders, who work mainly with this type of welding, at 29 enterprises have been investigated. Measurements of the breathing zone concentrations of dust and ozone and nitrogen oxide gases have been made. Carbon monoxide was detected occasionally in unimportant concentrations only and therefore was not systematically measured. The dust samples have been analyzed for such elements as iron, chromium and nickel. Background concentrations of the substances studied have also been determined. 42 % of the observations of dust concentration in the breathing zone (inside the welding mask) were above the current occupational health standard in Sweden for the respirable fraction of inert dust, i.e. 5 mg/m^3. Most of the observations for MIG-welding were not in compliance with the standard (MIG = Metal Inert Gas, a melting electrode which is consumed during the welding operation is used. In Sweden the shielding gas is argon). TIG-welding gave a lower dust concentration (TIG = Tungsten Inert Gas. The electrode is a non melting tungsten electrode. In Sweden the shielding gas is argon).

In this investigation neither the welding current nor the alloying metals in the base metal or in the electrodes affected the dust concentration. In two cases the chromium concentration in the breathing zone of the welder was higher than the occupational health standard in Sweden, 0,05 mg/m^3, assuming that the chromium was entirely hexavalent and thus stoekiometrically calculated as chromium trioxide. Chromium is present in small concentrations in aluminium as alloying material or as a contaminant in the base metals or the electrodes. Other metals, e.g. nickel, copper, zink and manganese were found in small concentrations well below the current health standards.

Nitrogen monoxide and nitrogen dioxide (both sampled outside the mask) were formed in concentrations below the current occupational health standards. In almost half the cases of MIG-welding ozone (sampled inside the mask) was found in concentrations numerically above the occupational health standard, 0,1 mg/m^3 and in 15 % of the cases above three times that limit, 0,3 mg/m^3. This latter value corresponds to the acceptable excursion factor at that concentration level. The concentrations of ozone and nitrogen oxides were not influenced by the welding current or by the alloying materials. There was no correlation between the dust concentration and the concentration of ozone or nitrogen oxides in the breathing zone. The proportion of the time during which the welding arc is lit did not correlate with the ozone concentration. Therefore the observed parameters of production, current and base metal and electrodes have not been shown to influence the formation or air contaminants, notwithstanding that such an influence has been reported in the literature for laboratory investigations. There was a difference in quantity of air contaminants formation during MIG- and TIG- welding. The variations in air contaminants concentration within these two main types of welding must be explained by unobserved or nonobservable variation e.g. in the technique of the welder, the dimensions and position of the object being welded. These variations obviously mask other effects.

A cross–sectional study of workers welding more than 44 % of their working day for at least one year has been made. The investigation covers 77 welders, of whom 64 were born in Sweden while 13 were immigrants, all males. Age-matched controls working in the metal industry were selected.

Among the complaints registered in the group under study were metal-fume fever, sweet taste and arc-eye. It was not possible to relate these findings to any particular exposure levels. Nor did we find any difference between the welding group and the control group with respect to the frequency of gastritis, childlessness or hospitalization. Chronic bronchitis was somewhat commoner in the welding group (4/64) than among the controls (2/64). The welders complained of back pains more frequently than did the controls. Stress during work was felt more often in the welding group, while satisfaction with work was about equal in the groups investigated. The frequencies of shift and piece-work respectively were about the same in both groups. Eye and respiratory trouble during work was more frequent among the welders than among the controls. It was possible to relate the frequency of respiratory complaints to the ozone concentrations measured. No difference respecting blood pressure or proteinuria was observed as between the groups. X-ray of the lungs revealed no abnormalities indicating pneumoconiosis. Spirometric measurements with a vitalograph showed no difference between the groups.

A small group of welders and controls were examined in the morning before starting work and in the afternoon after work. In the welders who smoked we found a significantly greater decrease in FVC during the working day than in the controls. The welders both smokers and non-smokers, had a slightly greater number of circulatng leukocytes than that found in the controls. The number of circulating leukocytes and the level of the serum-transaminase activity were also studied during a working day, but results showed no differences as between the groups.

Arbete och Hälsa 1978: 7

Per Höjerdal and Sven Alenius . . .
Determination of the efficiency of oil mist precipitators. Methods and results.

A method for testing the efficiency of oil mist precipitators has been developed. Efficiency variations in time and particle size have been determined as well as the variation of the vapour phase of the oil mist.

The oil mist concentrations have been measured with two direct reading instruments. Measurements of the total oil mist concentrations (approx. 100 mg/m^3 before the precipitator) and the vapour phase concentrations (0.1 - 2.5 mg/m^3 before precipitator) have been performed with a hydrocarbonmeter (range 0.1 - 300 mg/m^3) based on a flame ionization detector. A particle counter has been used to determine the size distribution of the liquid drops in the size range from 0.3 to 5 microns before and after the precipitator.

Arbete och Hälsa 1978: 8

Ulf Ulfvarson, Ulf Hallne, Tom Bellander, Bengt Sjögren and Åke Swensson:
Work environment problems in welding. 5. Welding in stainless steel with metal arc-welding with covered electrodes and gas-shielded welding.

The aim of the present investigation has been to measure the air-contaminants found in practical welding in stainless steel with metal arc-welding and gas–shielded welding in work places. In the case of metal arc-welding the places of work studied by us comprised about half of the work places in Sweden in which welders are mainly occupied with the operation under study. As regards gas-shielded welding the study is probably less representative, but the places of work we visited were sufficiently numerous to make the results arrived at of value for a general assessment of the situation. In 18 enterprises 86 work places where metal arc-welding with covered electrodes was carried on were investigated. In 14 enterprises, including some from the above-mentioned 18, 41 places of work with gas-shielded welding (MIG and TIG welding) were also visited.

In the breathing zone (i.e. the zone inside the welder's mask) measurements of dust analysed for e.g. iron, chromium, nickel and flourides, and for the gases ozone and nitrogen oxides were made. Particles were sampled in a way ensuring that the measurements should be representative for the whole work shift of the welders. The measurements of ozone, on the other hand, refer only to the welding operation in each particular case. Carbon monoxide was accordingly not measured systematically. Measurements of the substances mentioned above were made to determine the background concentrations in the general atmosphere of the work room.

One third of the observations of total dust in the breathing zone made during metal arc-welding were above 5 mg/m^3, which is the Swedish occupational health standard for inert dust respirable fraction. In the case of gas-shielded welding the exposure is above this standard only as the exception that proves the rule.

There is evidence of the presence of chromium in metal arc welding, for the most part in hexavalent form. The Swedish occupational health standard for chromium trioxide is 0.05 mg/m^3. Failure to meet this standard was found in 85% of all observations of metal arc-welding and in one third of the observation of gas-shielded welding. In gas-shielded welding probably a small part of chromium is in soluble, hexavalent form. In enterprises using metal arc-welding in stainless steel failure to meet the chromium trioxide standard was observed in one fourth of the background readings in the work rooms. There was good correlation between the dust concentration in the breating zone and the corresponding chromium concentration in the case of stainless steel welding. It was found that when the dust concentration was 1 - 2 mg/m^3 the cromium concentration calculated as chromium trioxide was about 0.05 mg/m^3 in both metal arc-welding and gas- shielded welding.

Failure to meet the occupational health standard for nickel (0.1 mg/m^3 according to the American Conference of Govermental Industrial Hygienists 1976) was rare. For the other metals investigated the concentrations proved to be much below the occupational health standards. In none of 13 cases of welding with basic (low hydrogen) electrodes was the occupational health standard for fluorides (2.5 mg/m^3) exceeded.

Ozone concentrations considerably below the Swedish occupational health standard (0.1 ppm) were found in the case of metal arc-welding, while this figure was exeeded in almost one fifth of the work places using gas-shielded welding. Since the figure refers to a time-weighted average standard, deviations may be acceptable up to three times the given concentration, which is exceeded in almost 10 per cent of the cases under study. MIG welding (Metal Inert Gas Welding, where the electrodes is melted and consumed) in stainless steel seems to show higher ozone concentrations than does TIG welding (Tungsten Inert Gas Welding, where the electrode is not melted). The shielding gas in Sweden is argon.

The concentrations of nitrogen oxides met the Swedish occupational health standard (ceiling 5 ppm) for both the types of welding mentioned. About 90 per cent of the work places investigated had 1 ppm nitrogen dioxide or less outside the mask of the welder.

In the work places covered by this study local exhaust ventilation was occasionally used. In the case of metal arc-welding this had a measurable effect on the concentrations of dust and nitrogen oxides, though it was not able to reduce the concentration of chromium to acceptable figures. The effect of local exhaust ventilation in the case of gas-shielded welding was not measurable.
The composition of electrodes and base metals had no measurable connection with the concentrations of total dust or gases in the breathing zone of the welder. On the other hand, the concentrations of various substances in electrodes and base metals did exert an influence on the concentrations of the same substances (metals) in the breathing zone of the welder. The current did not influence the concentrations of dust and gases, though the kind of current, direct or alternating, did have an effect, alternating current giving lower dust concentration than direct current. Other conditions during the operation which were not studied, such as welding position, dimensions of the object worked upon and the technique of the welder, obviously had greater effects on the emission of air-contaminants than had the factors studied, e.g. electrodes and current.

A cross-sectional study of workers welding more than 44 per cent of their working day for at least one year was done. The study covers 58 welders, 46 of whom were born in Sweden, while 12 were immigrants, all males. Age-matched controls working in the metal industry were selected.

Among the complaints registered in the welding group were metal-fume fever, sweet taste and arc-eye. It was not possible to related these findings to any particular exposure levels. Nor did we find any difference between the welding group and the control group with respect to the frequency of gastritis, childlessness or hospitalization. Stress during work was felt more often in the welding group, while satisfaction with work was about equal in the groups under study. Piece-work was commoner in the welding group, while the frequency of shift work was about the same in both groups. Chronic bronchitis was observed more frequently in the welding group (4/46) as compared to the controls (2/46): the difference was not, however, statistically significant. The frequency of fatigue and noise, eye and airway complaints during work was higher among the welders. The frequency of complaints referring to the airways was related to the chromium concentrations, but not to the dust concentrations measured by us. There was no difference between the groups as regards blood pressure or proteinuria. X-ray of the lungs showed no abnormalities indicating pneumaconiosis. Spirometric measurements with a vitalograph showed no difference between the groups.

Arbete och Hälsa 1978: 9

Carl-Johan Göthe:
Fibrous dust and its biological effects

A review is made of published studies of the effects of fibre dimensions (length and diameter) in in vitro and in animal experiments. Furthermore, the results of group examinations and epidemiological studies of populations exposed to glass fibres are summed up.

A connection between the fibrous structure as such and the biological effects of the fibrous particles are demonstrated in in vitro studies and in animal experiments in which particles are implanted or particle suspensions are injected directly into the pleural or peritoneal cavities of the animals. The fibrogenic and tumorigenic effects can be demonstrated when the fibres are longer than 10 µm. The fibrogenic effect increases with increasing diameter, while the tumorigenic effect seems to be limited to fibres thinner than 0,5-1.5 µm.

However, glass fibres have been shown to be rather inert in experiments where the particles have been introduced via the respiratory tract. In such experimental models, tumorigenic activities of glass fibres have not been demonstrated. This is in good agreement with the experiences from human populations occupationally exposed to glass fibres. Here, there is a difference between fibres from glass and asbestos. The reason could be that glass fibres only can be fragmented transversely so that they become shorter, while asbestos fibres also can be fragmented longitudinally so that they become thinner.

Even if we do not need to be alarmed at the fibre exposures in ordinary occupational environments where traditional glass-fibre products are produced and handled, it could be wise to prevent a future technological development that could cause exposure to very high levels of thin and long fibres. This could be achieved by introducing a maximum allowable concentration (MAC) for such fibres.

A MAC for airborne fibres, irrespective of their physical type and chemical composition, can be higher than a MAC for airborne asbestos fibres. For reasons discussed in the article, the MAC ought to be limited to fibres longer than 5-10 µm, shorter than 100-200 um and thinner than 0.5-3 µm. The MAC should also be related to the analytical technique used for control. MAC:s that are in force today for fibrous dust are founded on optic microscopy of dust samples. However, considerably more fibres could be detected with electron microscopy than with optic microscopy of the samples. Electron microscopy has definite advantages in this context, because the critical fibre diameters are close to or below the resolution power of optical microscopes.

It is also necessary to discuss the defintion of a "fibre". According to the present practice, fibres are particles with a length/diameter quotient ≥ 3. However, the specific aerodynamic properties that distinguish a fibre from a granule are not developed until this quotient is about 10 and upwards.

Arbete och Hälsa 1978:10

Francesco Gamberale, Bengt Knave, Sven Bergström, Elisabeth Birke, Anders Iregren, Birgitta Kolmodin-Hedman and Arne Wennberg:
Exposure to electric fields.

In the present epidemiological study, 53 workers with a long-term (more than five years) exposure to the electric field of 400 kV substations were examined and compared with a matched control group of 53 non-exposed workers from the same power company. Matching considered age, geographical localisation and employment time. The aim of the study was to investigate if there were any persistent, chronic health effects in the exposed group as a consequence of exposure. The investigation included the nervous system (neurasthenic symptoms, psychological tests, EEG), cardiovascular system (symptoms, blood pressure, EEG), the blood (hemaglobin, red blood cells, reticulocytes, white blood cells including differential count, trombocythes, sedimentation rate). Fertility was assessed regarding the number of children (boys/girls).
The results showed no differences between the exposed and control groups as a consequence of the long-term exposure to the electric fields. The groups differed, however, in that the exposed group had 1) consistently better results in the psychological performance tests, 2) fewer number of children, especially boys, and 3) somewhat higher education. The differences in test results were due to the higher education among the exposed. The difference in number of children was also thought to be related to factors other than exposure since the difference in number of children was found to be present already 10 - 15 years before the work in 400 kV substations.

Finally, evaluation was also attempted as to any "acute" effects of exposure, i.e. exposure to the electric fields at some time during the last 14 days before examination. The performance

in the psychological tests was found to be lower among the "acute" exposed as compared with "non-acute" exposed. No other results indicated the presence of an "acute" effect.

Single copies of the publications of the Board mentioned in this Newsletter are submitted free of charge to foreign addresses on request. See order form.

OTHER NEW REPORTS PUBLISHED BY THE BOARD

Investigation report 1978: 11, 17 pages.

Ingvar Holmér:
Physiological responses during the changing of the guard in cold and hot weather, *In Swedish.*

The English summary of the report is reproduced below.

A physiological investigation was performed on eight musicians from the Regionmusiken during the Changing of the Guard. Body temperature, skin temperature, heart rate, and sweat loss were measured during work in cold and hot climates as well. Work intensity was low and heart rate averaged 95-100 beats/min. In cold weather low finger skin temperatures (10-12°C) and hand skin temperatures (15-20°C) were recorded, although body temperature remained fairly unchanged. In hot weather heart rate was increased. Body temperature rose by 0.7°C on an average and sweat loss amounted to 0.5 1/h. Measures should be adopted in order to reduce peripheral cooling in cold weather and prevent excessive heat strain in warm climates.

Investigation report 1978: 12, 15 pages.

Per Lövsund, Kjell Hansson-Mild, Ronnie Lundström, Bertil Nordström, Sven-Erik G. Nilsson and P. Åke Öberg:
Static magnetic fields at an electrolytic plant. *In Swedish.*

Investigation report 1978: 13, 42 pages.

Johnny Hedendahl, Per Löfstedt and Ludwik Liszka:
The influence of the engine speed for the generation of low frequency sound in truck cabins. *In Swedish.*

Investigation report 1978: 14, 82 pages.

Gudrun Hedberg, Marianne Björkstén, Elisabeth Ouchterlony-Jonsson and Bengt Jonsson:
Engine drivers' body measures and occurence of pains in joints and muscles in relation to design of the drivers' cabin. Report 2. *In Swedish.*

Investigation report 1978: 16, 22 pages.

Mats Levin:
Occupational exposure of solvents, dust and some metals in spray painting. Report 13. *In Swedish.*

Change of address:

Write to

International Secretariat,

Arbetarskyddsstyrelsen,

National Board of

Occupational Safety

and Health,

Fack,

S-100 26 Stockholm,

Sweden.

Investigation report 1978: 17, 30 pages.

May Hultengren, Berit Widholm and Ewa Wigaeus:
Measurement of styrene in connection with production of receptacles of reinforced ester plastic. *In Swedish.*

Investigation report 1978: 18, 10 pages.

Jan-Olof Levin, Christoffer Rappe and Carl-Axel Nilsson:
The paramedic's exposure to bactericides. *In Swedish.*

Investigation report 1978: 19, 12 pages.

Göran Blomqvist, Bengt Christensson and Staffan Krantz:
Analysis and sampling of chromium (VI). II. Investigation of methods for sampling and analysis of chromic mist.

The English summary of the report is reproduced below.

The aim of the project was to investigate sampling- and analysis methods for Chromium (VI) in chromium plating industries. A comparison between the diphenylcarbazide method and atomic absorption was performed. 50 analyses of samples with the diphenylcarbazide method and atomic absorption gave a correlation factor of 0,986.

Investigation report 1978: 20, 35 pages.

Margareta Winell:
A base for evaluation of carcinogenic effects. II. Some alkylizing substances. *In Swedish.*

FROM THE BOARD'S FOREIGN VISITORS FILE

26 May 1978
Dr Bohlmann and Mr Mörner, Dolmar Maschinen-Fabrik GmbH & Co, Hamburg. West-Germany.

19 June
Mr Robert T. Hughes, NIOSH, Ohio, USA.

17 July
Mr John F. Helding, Mt Hood Community College, Oregon, USA.

14 August
Mr Richard Shore, Dept of Labour, USA.

16 August
Mr Basil J. Whiting, Deputy Assistant Secretary, OSHA, USA.

21-25 August
Mr Kiara, Chief Inspector of Factories, Nairobi, Kenya.

No. 2 August 1978

Please note that, if not otherwise indicated the publications exist in Swedish only.

ORDER FORM

To be sent to

National Board of Occupational Safety and Health
Arbetarskyddsstyrelsen
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☐ Methods Report No. .....

☐ Investigation Report No .....

☐ Training Report No. .....

☐ List of research projects in progress at the Board's Occupational Health Department. In English.

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NEWSLETTER

National Board of Occupational Safety and Health · Arbetarskyddsstyrelsen · Sweden
Mailing address: Fack, S–100 26 Stockholm · Telephone: 46-8-54 02 60 Publisher: Gunilla Warnbeck

No. 3 1977

THE BOARD'S BUDGET PROPOSALS FOR THE FISCAL YEAR 1978/79

The National Board of Occupational Safety and Health and the Labour Inspectorate employ at present 986 persons. The allocations granted to the Board and the Labour Inspectorate for the fiscal year 1977/78 totalled more than Skr 131 million.

In the budget proposals for the fiscal year 1978/79 the Board demands an increase of Skr 65 million and 236 new posts, i. e. a total budget of close to Skr 197 million or U.S. $ 40.6 million (in the monetary value of September, -77) and a total staff of 1 222 persons.

Of the reguested budget increase of Skr 65 million a sum of Skr 40 million is intended for the Board and the remaining Skr 25 million for the Labour Inspectorate. Of the 236 new posts requested 41 are meant for the Board and 95 for the Labour Inspectorate.

The Board stresses that the new Work Environment Act will make heavy demands on the Board and the Labour Inspectorate. The Act will come into force on July 1, 1978. The Board further emphasizes that the five-year plan of expansion suggested in its budget proposals for 1977/78 ought to be continued.

NEW DIRECTIONS OF THE BOARD

Dock Work

The Board's **Directions No 1, Dock Work,** concerning protective measures while loading and unloading ships, came into force on July 1 st, 1977. The directions have been translated into *English* and can be ordered from the Board.

The directions contain general directions about co-ordination between several employers, supervision and instruction of employees, special directions about workplaces, approaches, equipment and devices, general directions about the performance of dock work, personal protective equipment. Standards for testing of lifting appliances as well as handling and securing of freight containers appended.

Pole climbing irons

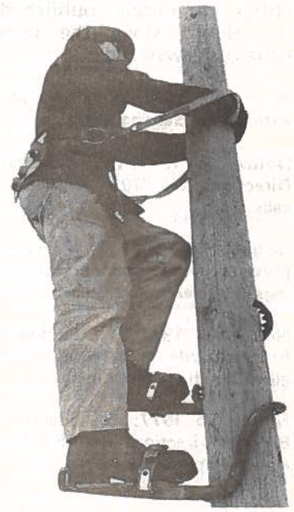
The Board's Directions No. 118, concerning the design, use and care of **Pole climbing irons** will come into force from 1 st January 1978.

These directions refer primarily to pole climbing irons for use on wooden poles. Where relevant they also apply to climbing irons intended for poles of other materials, e. g. steel or concrete. New pole climbing irons must not be supplied for use unless they are of a design approved by the National Board of Occupational Safety and Health.

When delivered, pole climbing irons must be accompanied by written instructions concerning their use and care. Pole climbing irons must have crampons or similar devices which will give the wearer a firm hold on the pole but can easily be detached from it. Pole climbing irons with adjustable grip width must be securely lockable in the desired position. Straps and other fastening devices must be arranged in such a way that, when in use, the pole climbing irons will firmly and securely attach to the wearer's shoes and can easily be removed and put on. Pole climbing iron should remain firmly attached to the pole when the wearer climbs out of them. Pole climbing irons must be well balanced and should be of light weight.

The employer must ensure that pole climbers are inspected at least once per calendar year by a person appointed by him for the purpose and well acquainted with the use and care of pole climbers. This person may be in the service of the employer. Pole climbing irons must be marked with their year of manufacture and, if they pass the annual inspection with the month and year in which the inspection took place. An inspection is also to be carried out if a pole climbing iron has been subjected to abnormal stress, e. g. if it has been driven over or if it has fallen to the ground from a pole.

Employees using pole climbing irons must check them daily. This check must at least include the removal of dirt from the foot plate and grips, together with a visual examination for deformation, cracks, worn crampons etc. and the state of the straps. Before climbing a pole, the wearer must check the reliability and grip of his pole climbing irons by swaying slightly at the first step.



If an inspection or check reveals any defect in the pole climbing irons, they are to be taken out of service immediately and the foreman notified accordingly. The pole climbing irons may not be used again until the defects have been remedied.

Crampons may only be sharpened as instructed by the manufacturer and by a person especially trained for the purpose. Straps which are worn or otherwise unsuitable are to be replaced with new, serviceable straps of a suitable synthetic material, e. g. terylene. Pole climbing irons are to be discarded if they are found to be deformed or cracked or if they are heavily worn or corroded. Pole climbing irons which have been used to a normal extent throughout the year are to be discarded after ten years' service at the latest.

Employees using pole climbing irons must have undergone suitable training for this type of work. The training

must include work technique using pole climbing irons, practice in climbing poles of different sizes and of different materials, and information concerning the physical strain involved by such work. The training must also include practice in the use of a safety belt and line, together with instructions concerning the recovery of personnel in distress from poles and procedure in connection with the daily checking of pole climbing irons.

A safety belt and line must be used when working on a pole and, wherever possible, when climbing a pole. A safety helmet must be worn when working on a pole and when in the vicinity of a pole. Pole climbing irons may only be used for the purpose for which they are intended. They may not be used, for example, as tools for lifting, twisting or pulling.

Other directions published by the Board since the previous issue of Newsletter.

Notice No 1977: 14 Minors at work with power clearing saws

Notice No 1977: 15 Amendment to Directions No 103, Building crane cabs

Notice No 1977: 16 Welding of pressure vessels and compressive pipings in nuclear power plants

Notice No 1977: 17 Delamination of formaldehyde in particle boards and glued building components

Notice No 1977: 18 Addenda to the Board's Directions No 98, Hydraulic and pneumatic presses

NEW ISSUES OF "ARBETE OCH HÄLSA"

The Board's scientific series "Arbete och hälsa" contain results of the research carried out within the Board's Occupational Health Department. As a rule the issues *appear in Swedish with a summary in English.*

Summaries of the latest issues follow below.

Arbete och hälsa 1977: 6

Dag Resare and Åke Swensson:
An inquiry concerning the health status among workers in Swedish cemented tungsten carbide industry.

In an inquiry among 2203 workers in Swedish cemented tungsten carbide industry the frequency of coughing, chronic bronchitis and dyspnoea were reported in higher frequency in exposed groups than in control groups. Age and smoking habits had some influence on the frequencies but could not explain the differencies between the exposed groups and the control groups.

The results indicate the need of an investigation to elucidate this problem.

Arbete och hälsa 1977: 7

Birgitta Kolmodin-Hedman, Marianne Håkanssson, Ester Randma, Karin Bergman and Åke Swensson:
Exposure of workers treating conifer plants with DDT or lindane.

Groups of workers treating plants with DDT or lindane were studied. Different methods of treatment were studied, dipping, spraying in a spray tunnel and spraying on the field. Furthermore exposure in connection with handling of the treated plants was studied and the concentration of the substances in the air above treated plants.

The exposure was determined as concentration in the air and both personal and stationary air sampling was used. The uptake was studied measured as the plasma concentration of the substances.

The exposure varied a great deal but the concentration of lindane or DDT in air was never higher than 1/2 of the AmericanTLV value.
On the whole no uptake of DDT (increased of DDT in plasma) could be demonstrated. Working with lindane gave a small, variable but significant increase of the lindane concentration in plasma, which disappeared very rapidly when exposure stopped. The concentration of lindane in plasma never was so high as to cause induction of liver enzymes.

No symptoms related to the exposure were registered.

Arbete och Hälsa 1977: 8

Thomas Lindqvist:
The partition coefficients blood/air and water/air for some common solvents.

The partition coefficients between blood and air and between water and air were determined for nine different solvents. The method used was a modified version on one previously applied by Sato. The method consisted in adding solvent to a bottle containing a known quantity of blood or water and after equilibrium analysing the air phase according to the headspace method. Partition coefficient between blood and water was calculated by dividing the blood/air coefficient with the water/air coefficient.

The results showed that n-butyl alcohol and acetone, which in comparison with the other compounds are highly soluble in water, had partition coefficients between blood and air which considerably exceeded those of the other solvents. The partition coefficient between water and air for n-butyl alcohol and acetone was very similar to the partition coefficient between blood and air for these compounds. The other solvents can be ranked with regard to their partition coefficients, starting with the solvent with the highest value, as follows: styrene, trichloroethylene, toluene, chloroform, dichloromethane, benzene, methylchloroform.

The study also showed that the biological variation including error of the single determination differed for the solvents studied, with trichloroethylene and methylchloroform showing greatest variation, presumably as a result of binding to different components in the blood.

Arbete och Hälsa 1977: 9

Jörgen Engström and Rasmus Bjurström:
Methylene chloride exposure. Concentrations in subcutaneous adipose tissue.

The fat content of the body was calculated in twelve healthy male subjects aged 21 to 35 years by means of hydrostatic weighing and antropometric estimation of skeletal weight. The subjects were exposed to a concentration of 2600 mg methylene chloride per cubic meter of inspired air (750 ppm) for one hour while performing work at an intensity of 50 W on a bicycle ergometer. The uptake in the organism was measured continuously using the Douglas' bag technique. The amount of methylene chloride absorbed was highly correlated to the degree of obesity and to the body weight. Needle biopsy specimens of subcutaneous adipose tissue were taken from the buttocks before exposure and 0, 1, 2, 3 and 4 hours after exposure. The mean yield of tissue from the 60 biopsies was 25 mg. The concentration of methylene chloride in the adipose tissue was determined by gas chromatography, using a head space-method. The mean concentration was 10,2 mg/kg one hour after exposure and 8,4 mg/kg after 4 hours. There was a wide distribution around the mean values. In the 6 slim subjects the concentration in the adipose tissue during the 4 hours after exposure was on an average twice that of the 6 more obese subjects. On the other hand, in spite of lower concentrations, the obese subjects had a greater calculated amount of methylene chloride in the total fat depots of the body. Two subjects were studied about 22 hours after exposure, the concentration in subcutaneous adipose tissue being 1.6 and 1.7 mg/kg respectively at that time.

Arbete och Hälsa 1977: 10

Ann-Sofie Kindblom, Ann Nordström and Ingvar Holmér:
Heat stress during sedentary work.

This aim was to study physiological effects and subjective experience during sedentary work in two different climates (air temperature 40°C and relative humidity 40% (40), and 32°C and 80% respectivelv (32)), both of which corresponded to approx, 32°C SWBGT (a modification of the WBGT) = 0,7 x psychometric wet-bulb temperature + 0,3 globe temperature (+ 2 when air velocity is lower than 0,5 m/s). Four men and four women participated in the study. Each subject was exposed to both climate conditions during 90 min. Body temperature, skin temperature, heart rate and body weight were measured continuously. At certain intervals during exposure subject rated subjective temperature and comfort. There were clear differences between the conditions as regard physiological reactions, where heart rate, mean skin temperature and sweating intensity were higher at 40 than at 32. The mean rise in body temperature was approx. 0,2-0,3°C. All subjects rated the climate at 40 to be warmer and more uncomfortable than at 32. During the last half-hour of exposure air velocity was increased with the aid of a fan. This increased the heat loss at 32 and resulted in a decrease in mean skin temperature. At 40 the intensity of sweating increased. The increased air velocity had a positive effect on subjective comfort. Certain differences between the sexes were found, where the men had a higher sweating intensity and reported more discomfort than the women. The results of the study illustrate that an index such as SWBGT cannot effectively be used to evaluate which factors in the thermal environment effect the physiological and psychological load during sedentary work in heat.

Arbete och Hälsa 1977: 11

Per Gustavsson:
Diisocyanates. A review of the literature on medical and toxicological observations.

Animal experiments, case reports and epidemiological studies concerning medical effects of diisocyanate exposure are reviewed. A summary is given of each study cited.

Single copies of the publications of the Board mentioned in this Newsletter are submitted free of charge to foreign addresses on request. See order form.

OTHER NEW REPORTS PUBLISHED BY THE BOARD

Investigation report 1977: 14, 10 pages.

Bo Dahlner and Bo Holmberg:
Cyanogen chloride - a base for an occupational standard. *In Swedish.*

The summary in English from the report is reproduced below.

Exposure to cyanogen chloride may occur industrially during certain technological processes for purifying water contaminated with cyanides. Results of measurements indicate that the concentration of cyanogen chloride in the air at such a process very well may exceed the irritation limit. The biological effects of cyanogen chloride are summarized, and an occupational standard (time weighted average) of 0.1 ppm is proposed in order to minimize irritation.

Investigation report 1977 : 15, 11 pages.

Göran Blomquist, Jan-Olof Levin and Carl-Axel Nilsson:
Analytical methods for organic substances on the TLV list. I.Benzylchloride, dichlorobenzene, dinitrobenzene, nitropropane. *In Swedish.*

A summary in English from the report is reproduced below.

Sampling of benzylchloride and dichlorobenzene in the atmosphere of working environments is done by absorbing the substances on activated charcoal. Sampling of dinitrobenzene and nitropropane is done by absorbing the substanes in ethanol. All these substances are analysed by gas chromatography.

Investigation report 1977: 16, 17 pages.

Bengt Christensson, Staffan Krantz and Pertti Kuusisto:
An investigation of different volume measurement methods used in personal dust sampling. *In Swedish.*

Investigation report 1977: 17, 12 pages.

Staffan Krantz and Birgit Larsson:
Elutriation - sedimentation. A comparison between two methods for determining respirable dust. *In Swedish.*

Investigation report 1977: 18, 9 pages.

Maria Steby:
Occupational exposure of solvents, dust and some metals in spray painting. Report 5. *In Swedish.*

Investigation report 1977: 19, Part I: 100 pages.

Bo Holmberg and Birgitta Sjöström:
A toxicologic review of rubber chemicals. *In Swedish.*
Part II: 19 pages.

Sven Olsson:
A recommendation for elimination of chemical hazards. *In Swedish.*

Investigation report 1977: 20, 50 pages.

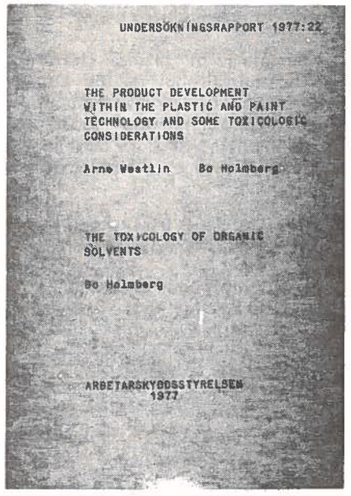
Elisabeth Lagerlöf:
Experimental activities concerning occupational injury claim. *In Swedish.*

Investigation report 1977: 21, 11 pages.

Maria Steby:
Occupational exposure of solvents, dust and some metals in spray painting. Report 6. *In Swedish.*

Investigation report 1977: 22, 17 pages.

The report contains two papers presented at the International Conference on Health Hazards in Painting Trades held in Geneva in September 23-24, 1976. *The whole issue is in English.*


UNDERSÖKNINGSRAPPORT 1977:22

THE PRODUCT DEVELOPMENT WITHIN THE PLASTIC AND PAINT TECHNOLOGY AND SOME TOXICOLOGIC CONSIDERATIONS

Arne Westlin Bo Holmberg

THE TOXICOLOGY OF ORGANIC SOLVENTS

Bo Holmberg

ARBETARSKYDDSSTYRELSEN 1977

Part I.
Arne Westlin and Bo Holmberg:
The product development within the plastic and paint technology and some toxicologic considerations.

The summary from the report is reproduced below.

The introduction of synthetic paint materials during the last decades is briefly described and the toxicological aspects of some monomers, binding agents and solvents are summarized.

Part II.
Bo Holmberg:
The toxicology of organic solvents.

The summary from the report is reproduced below.

The acute and chronic effects of organic solvents present in paints and lacquers are summarized. The criteria used in US and USSR for establishing occupational standards for organic solvents as well as other levels of actions are discussed.

Investigation report 1977:23, 5 pages.

Mats Levin:
Measurement and occupational health assessment of optical radiation. IV. MIG and TIG welding in aluminium. *In Swedish.*

Investigation report 1977:24, 10 pages.

Jan-Olof Levin and Sven Olof Westermark:
Analytical methods for organic substanses on the TLV list. II. Phenol, furfural, furfuryl alcohol. *In Swedish.*

The summary in English from the report is reproduced below.

Sampling of phenol, furfural and furfuryl alcohol in the atmosphere of working environments is done by adsorbing the substance on Amberlite XAD-2. All these substances are analyzed by gas chromatography.

Training report 1977:4, 72 pages

Bo Dahlner and Per Övrum:
Sampling methods for gases and solvents. *In Swedish.*

Training report 1977:5, 124 pages

Bengt Jonsson, Thord Lewin, Paulus Tomsic, Gunnar Gärde and Per Forssblad:
The hand as a working tool. Summaries from a course presented at the Board's Industrial Medicine Contact Days 27-28 april, 1977. *In Swedish.*

NEW RESEARCH PROJECTS OF THE BOARD

The latest annual list in English of research projects in progress at the Occupational Health Department of the Board can be obtained from the Board. See order form.

Reports from the Swedish Work Environment Fund

In connection with the International Symposium on the Control of Air Pollution in the Working Environment, held in Stockholm in September 6-8, 1977 - and arranged by the Swedish Working Environment Fund and the International Labour Office (ILO) - five reports were published by the Fund. The reports give a summary of current research and the problems that remain to be solved. The publications are available in Swedish and in English. The reports deal with the following subjects:

Asbestos. On research and regulations in Sweden.

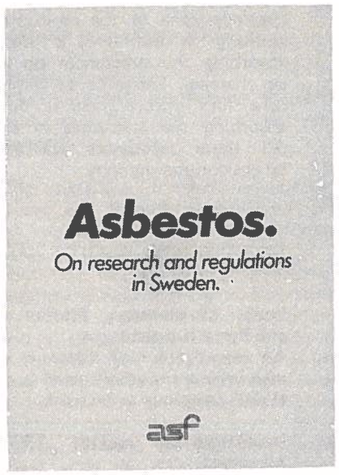
Silicosis. On research and regulations in Sweden.

Surface treatment. Research and new technical solutions for a better work environment.

Welding. Research and new technical solutions for a better work environment in the welding industry.

Metals. Health hazards of industrial metals - a selective survey.

The reports can be ordered from the Swedish Work Environment Fund. Address: Arbetarskyddsfonden, Sveavägen 166, S-113 46 Stockholm, Sweden.



FROM THE BOARD'S FOREIGN VISITORS FILE

23 May
Dr Magdalene Chan, Industrial Health Department, Republic of Singapore

24 and 27 May
Mr Philip Tan Nge Liang, Deputy Chief Inspector of Factories, Republic of Singapore

1 June
Mr Reg Groth, Member of the State Government of South Australia

6 June
Mr Kenneth Ramsay, Forestry Manager/Safety Officer, Scottish Woodland Owners' Association Ltd, Skotland

15 - 16 June
Mr David Biderman, Deputy Chief Inspector of Labour, Israel

27 June
Mr Hiroichi Ono, Ministry of Labour, Japan

10 August
Ms Charlotte Barnekow, Secretary to the Swedish Labour Counsellor in Brussels and Ms Eva Sunne, Secretary to the Swedish Labour Counsellor in Bonn

26 August
Mr Anil Karnik, Research Officer, National Institute of Occupational Health, India

9 September
Dr C de Meester, Verbond van Nederlandse Ondernemingen, Holland

12 September
Dr Edouard Cole, Ministry of Labour, Guinea

13 - 15 September
Mr George Kanellopoulos, Ministry of Labour, Greece

19 - 21 September
Messrs Steinar Johnsen, Lorentz D. Klüver and Bjørn Bjørnsen, Statens Arbeidstilsyn, Norway

19 September
Mr Nobuo Kageyama, The Japan Society of Mechanical Engineers, Japan

27 September
Mr Istvan Bukkösy, Director of Scientific Research Institute for Labour Safety of HTUC, Mr Lajos Föcze, Head of Labour Safety Dpt of the Central Council of Hungarian Trade Unions and Mr András Békés, Engineer, Hungary, Mr Reino Laitinen, Tammerfors and Mr Tapani Talvinko, Helsinki, Finland

28 - 29 September
Mr Rudolf Kemka, Engineer, Czechoslovakia

Reports in English or with English summaries based on research work carried out within the Board's Occupational Health Department to be found in scientific journals. 1976-01-01 -- 12-31.

Antti, C-J., Björkstén, M., Ericson, B-E. & Jonsson, B.
Relationship between work and integrated myoelectric activity in long-term vocational studies
Biomechanics V—A (ed. P Komi), University Park Press, Baltimore, pp 515-519.

Blomquist, G.:
Cross partition and determination of net charge of the isoenzymes of enolase
Biochim. biophys. Acta 420 (1976) pp 81-86.

Carlsson, A. & Lindqvist, T.:
Exposure of animals and man to toluene
Arbete och Hälsa 1976:11
Swedish with English summary.

Conradi, S., Ronnevi, L-O. & Vesterberg, O.:
Abnormal tissue distribution of lead in amyotrophic lateral sclerosis
J. neurol. Sci. 29 (1976) pp 259-265, 19 refs.

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Behavioral responses in experimental exposure to solvent vapor - experimental and field studies
Adverse Effects of Environmental Chemicals and Psychotropic Drugs. Val. 2. Neurophysiological and Behavioural Tests, pp 111-133. Elsevier Scientific Publishing Company, Amsterdam, 1976. 50 refs.

Gamberale, F., Annwall, G. & Anshelm-Olson, B.:
Exposure to trichloroethylene III. Psychological functions
Scand. j. work environ. & health 4 (1976) pp 220-224 12 refs.

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Heart rate and perceived exertion in simulated work with high heat stress
In: Physical Work and Effort, Proceed. of the First International Symposium Dec. 2-4, 1975, at the Wenner-Gren Center, Stockholm (ed.: G. Borg) Pergamon Press, Oxford, 1976, pp 323-332, 6 refs.

Gamberale, F., Lisper, H O. & Anshelm-Olsson, B.:
The effect of styrene vapour on the reaction time of workers in the plastic boat industry
Adverse Effects of Environmental Chemicals and Psychotropic Drugs, Val. 2. Neurophysiological and Behavioural Test, pp 135-148. Elsevier Scientific Publishing Company, Amsterdam, 1976. 17 refs.

Göthe, C-J., Övrum, P. & Hallén, B.:
Exposure to anaesthetic gases and ethanol during work in operating theatres
Arbete och Hälsa 1976: 10
Swedish with English summary.

Hallne, U. & Erlandsson, A.:
Work environment problems in Welding
Arbete och hälsa 1976: 5
Swedish with English summary.

Hansson, J-E.:
Factors affecting vehicle control
Paper No. 75-5527, ASAE Winter Meeting, Chicago, Dec. 1975. 7 p. (AMA 015/76).

Hansson, J-E.:
Vibrations in forestry machines
Proceeding, XVI IUFRO Congress, Div. III, pp 206-219, Oslo, June 1976 (AMA 018/76).

Hansson, J-E., Klusell, L., Svensson, G. & Wikström, B-O.:
Working conditions for truck drivers - A hygienic and ergonomical survey
Arbete och Hälsa 1976: 6
Swedish with English summary.

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Exposure to whole-body vibrations among drivers of forest machines
Arbete och Hälsa 1976: 14
Swedish with English summary.

Holmberg, B., Kronevi, T. & Winell, M.:
The pathology of vinyl chloride exposed mice
Acta vet. scand. 17 (1976) pp 328-342.

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Occupational hygienic standards - an international comparison
Arbete och Hälsa 1976: 13
Swedish with English summary.

Holmér, I. & Bergh, U.:
Hypothermia and physical work capacity of swimming man
Chapter 26 in Selected Topics in Environmental Biology (Ed.: Bhatia, Chhina & Singh), Interprint Publications, New Delhi-110028, India, pp 163-167, 12 refs.

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Abstr. Commun. 10th Internat. Congr. Biochem. Hamburg July 1976, p. 162.

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Occupational accident research. Papers presented on a seminar on Stockholm, Sweden, 1975. Arbetarskyddsfonden (Sveavägen 166, 10 tr, 113 46 Stockholm) 1976, pp 82-86. 7 refs.

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Separation of isoenzymes of acid phosphatase from Pinus silvestris by partition in aqueous polymer two-phase systems
Acta chem. scand. B 30 (1976) pp 83-85.

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Biomechanics V-A (ed.: P Komi), University Park Press, Baltimore, 1976, pp 261-266, 8 refs.

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Circulatory effects of isometric muscle contractions performed separately and in combination with dynamic exercise
Europ. J. appl. Physiol. 36 (1976) pp 7-17-28 refs.

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Endogenous prostaglandins as local regulators of blood flow in man: Effect of indomethacin on reactive and functional hyperaemia
J. Physiol. 257 (1976) pp 109-121, 26 refs.

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Health hazards in the use of solvents
IMF World Conference on Health and Safety in the Metal Industry, Oslo, Norway, 16-19 Aug. 1976. Report AMMF 112/76, Arbetarskyddsstyrelsen, 17 p. 13 refs.

Knave, B., Kolmodin-Hedman, B., Persson, H E. & Goldberg, J M.:
Chronic exposure to carbon disulfide: Effects on occupationally exposed workers with special reference to the nervous system
Abstract in Third Swedish-Yugoslavian symposium on occupational health, Stockholm, May 6th-11th, 1975. Ar-Arbete och Hälsa 1976: 8

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Long-term exposure to jet fuel. An investigation on occupationally exposed workers with special reference to the nervous system
Scand. j. work environ, & health 3 (1976) pp 152-164, 45 refs.

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Long-term exposure to jet fuel: An investigation on occupationally exposed workers with special reference to the nervous system
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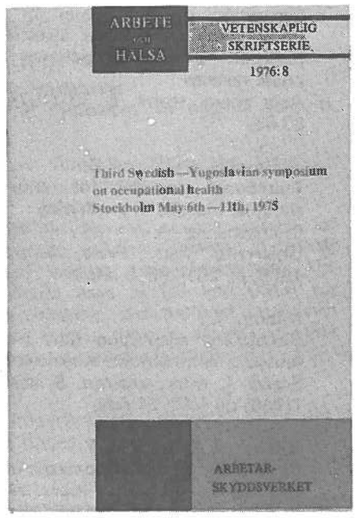

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Medical observations on personnel occupationally exposed to lindane in tree plant treatment and tree planting
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Infrared spectrometric analysis of quartz
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In Occupational Accident Research. Papers presented on a seminar in Stockholm, Sweden, 1975. Arbetarskyddsfonden, Stockholm, 1976, pp 9-21, 34 refs.

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In Occupational Accident Research. Papers presented on a seminar in Stockholm, Sweden, 1975. Arbetarskyddsfonden, Stockholm, 1976, pp 221-227, 11 refs.

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VIII. Error of measurement and interindividual differences.
Electromyogr. clin. Neurophysiol. 15 (1975) pp 525-536.

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Undersökningsrapport AMA 021/76
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Work place lighting in foundries and smelteries
Ljuskultur nr 4-5, 1976
Swedish with Abstract in English.

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A method for testing the capture degree of local exhaust systems
Arbete och Hälsa 1976:2.
Swedish with English summary.

Skare, I.:
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Undersökningsrapport AMTG 103/76
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Evaluation of indicator tubes. Part III. Formaldehyde
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A method for determining benzo (a)pyrene in air samples collected on glass fiber filters in occupational areas
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Safety regulations and their influence on safety at work
In Occupational Accident Research. Papers presented on a seminar in Stockholm, Sweden, 1975. Arbetarskyddsfonden, Stockholm, 1976, pp 53-58, 8 refs.

Ulfvarson, U.:
Absorption of gaseous air contaminants in human beings as a function of the partition coefficient between blood and air. Confirmation of a model
Arbete och Hälsa 1976:7
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Sampling strategy and statistical evaluation of results from sampling and analysis of air contaminants at work places
Arbete och Hälsa 1975:9
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Physical and chemical working environment factors in hotels and restaurants
Arbete och Hälsa 1976:9
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Ulfvarson, U. & Övrum, P.:
Partition of solvents between blood and air
I. Determination of the partition coefficient between blood and air for some volatile solvents
Arbete och Hälsa 1976:7
Swedish with English summary.

Wahlberg, J E.:
Percutaneous toxicity of solvents - A comparative investigation in the guinea pig with benzene, toluene and 1,1,2-trichloroethane
Ann. occup. Hyg. 19 (1976) pp 115-119, 6 refs.

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Sensitization and testing of guinea pigs with nickel sulfate
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II. Metabolites in blood and urine
Scand. j. work environ. and health 4 (1976) pp 212-219, 21 refs.

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J. occup. Med 18 (1976) No. 7 pp 473-476, 16 refs.

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Exposure to trichloroethylene monitored by analysis of metabolites in blood and urine
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Effects on human beings of solvents in the inspiratory air. - A new method for estimation of uptake
Arbete och Hälsa 1976:3
Swedish with English summary

Åstrand, I. & Övrum, P.:
Exposure to trichloroethylene
I. Uptake and distribution in man
Scand. j. work environ. & health 4 (1976) pp 199-211, 17 refs.

Åstrand, I., Övrum, P., Lindqvist, T. Hultengren, M.:
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-Uptake and distribution in man
Arbete och Hälsa 1976:12
Swedish with English summary.

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Exposure to butyl alcohol - Uptake and distribution in man
Scand. j. work environ. & health 3 (1976) pp 165-175, 10 refs.

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Paper read at the International Micrographics Congress, Stockholm, 28-31 sept. 1976. 10 p. 84 refs.

Östberg, O.:
In German

Zur Typologie der circadianen Phasenlage

Ansätze zu einer praktischen Chronohygiene
In "Biologische Rhytmen und Arbeit" (G Hildebrandt, Hrsg.) Springer-Verlag 1976, S. 117-137, 103 Ref.

Explanatory notes:

Reprints of the reports are only obtainable from the author(s), the publishing company or the scientific journal in question.

The Board'a scientific series "Arbete och Hälsa" (Work and Health) can - as long as stocks are available - be ordered from the Board. (address: see order form)

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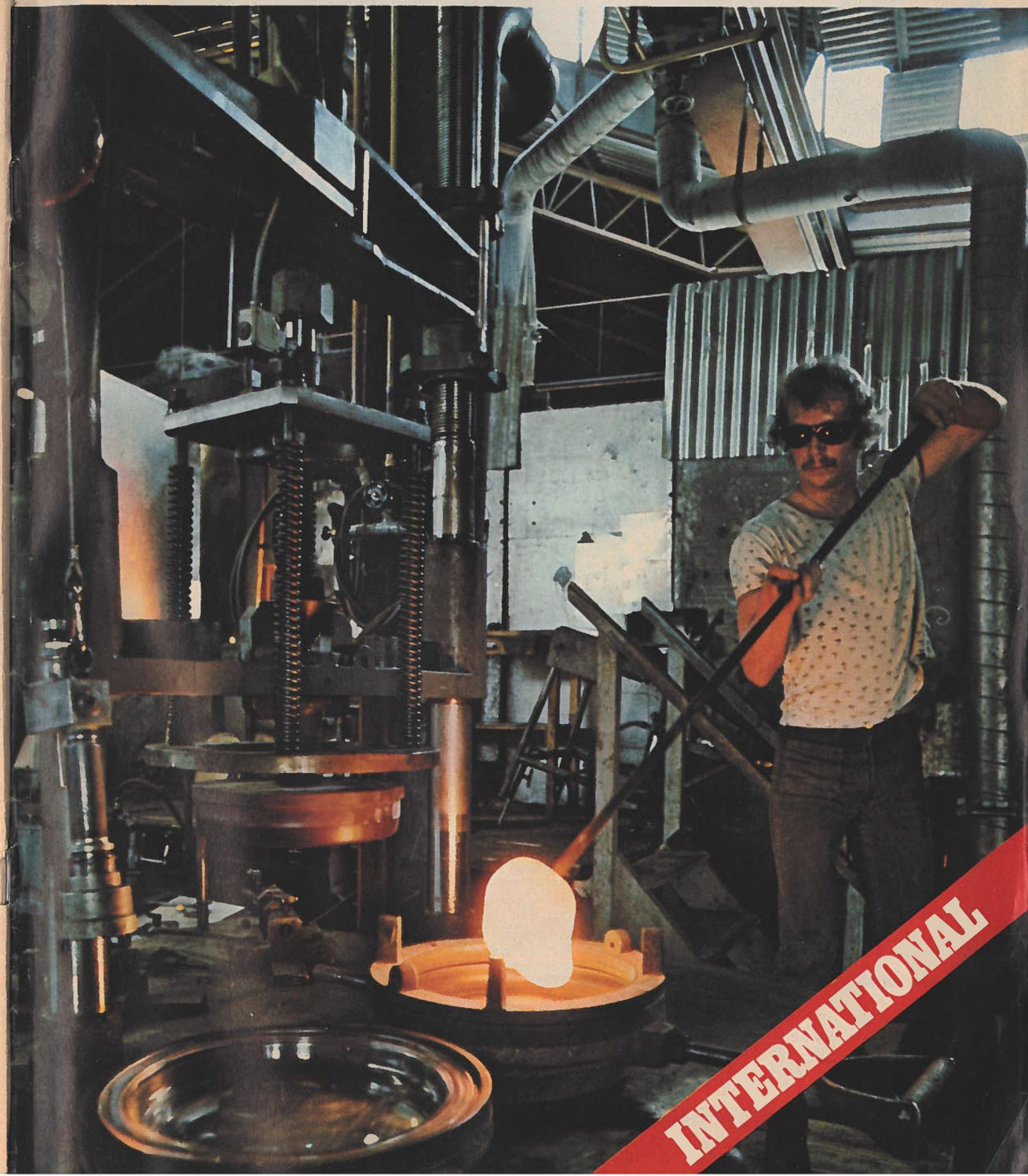
Working Environment

10 B/1977



CONTENTS

Arbetsmiljö International
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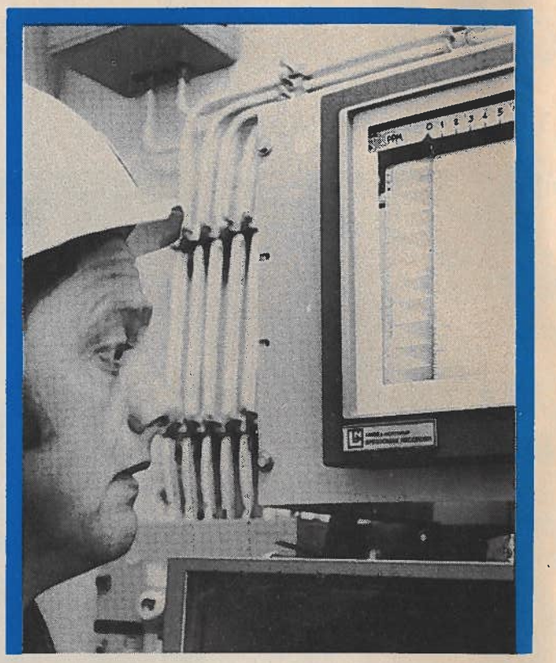
Cover
Heat resistant glass is Reijmyre's answer to the glass industry crisis. The Swedish glass industry is restructuring, and government helps – provided the industry cleans up its environment.



How to overcome the vinyl chloride hazard . 8
Sweden is the only country besides Denmark and the United States which has acted to stop the deaths by angiosarchoma, the rare liver cancer disease caused by exposure to vinyl chloride. The TLV of 1 ppm is observed by the only Swedish pvc producer KemaNord. Safety steward Bengt Sandin checking current exposure levels.

arbetsmiljö

"Working Environment"
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Let's spread the rings!

□ In May this year the 8th World Congress on Occupational Safety and Health was held in Bukarest. The congress followed the general pattern of previous meetings: reports from the international bodies, ISSA, ILO and others, followed by other reports from representatives of a number of countries. Two symposia were held in addition to the plenary sessions, one on prevention of hazards in the chemical industry, the other on the building and construction industry. The third branch that received special attention was agriculture.

World congresses like this one have become a useful and necessary routine. This year's congress in Bukarest was not much different from previous ones except for a few details: for the first time several speakers tried out the phrase "quality of life"! Representatives from both industrial and developing countries had acquired this new terminology. Progress!

Occupational Safety and Health as a concept is gaining wider usage. "Work Environment" is the term used in the Swedish Act. "Quality of life" and "living environment" are new terms which will be defined at the fair "Working Environment 77" to be held in Jönköping immediately after the ILO symposium in Stockholm.

It was very encouraging to hear in Bukarest how new countries have seriously and eagerly approached the task of providing organization and information in the field of occupational safety and health. The Nordic countries have had a head start. Now the work environment movement is spreading.

A third point, remarkable if you compare with previous world congresses, was the attempt to gather representatives of work environment magazines from all over the world to a joint session. The initiative came from the Dutch Veiligheidsinstitut. There are probably some 80 work environment papers and magazines in the world. A third of these had representatives in Bukarest. A beginning, I hope, of a coordinated effort in the field of work environment information.

It has often been said that questions of the environment know no boundaries. No single country is isolated in its situation. It must know the problems of others too. People in all countries have the same rights to sound and secure work environments. There is need, therefore, of active cooperation across the frontiers. We must be able to learn from each other's experiences in the struggle for a better work environment. In this task the work environment periodicals have a very important function. Language difficulties can be overcome. A greater cooperation and openness between researchers and journalists is necessary. They must understand and appreciate each other's functions. This, the editors in Bukarest found, was a key to international progress and understanding.

In the field of international cooperation there is a need for a greater understanding of the special problems of each country. Each country is unique. Rome was not built in one day, neither can a functioning occupational safety and health system be developed overnight. But a free flow of information between countries can hasten the development—like rings on water.

The Bukarest World Congress gathered 1,400 participants from 72 countries. They saw a country and a city that did not hesitate to act as hosts in spite of a catastrophe two months prior to the meeting that destroyed 32,000 homes, 1,800 schools, 800 factories and 44 hospitals. Everything worked well and the hosts looked after everything and everybody.

The same thing is true of Dublin 1974. The week before that congress was marred by several acts of terrorism. But the meeting was held without incident in spite of the excitement that the hosts must have felt.

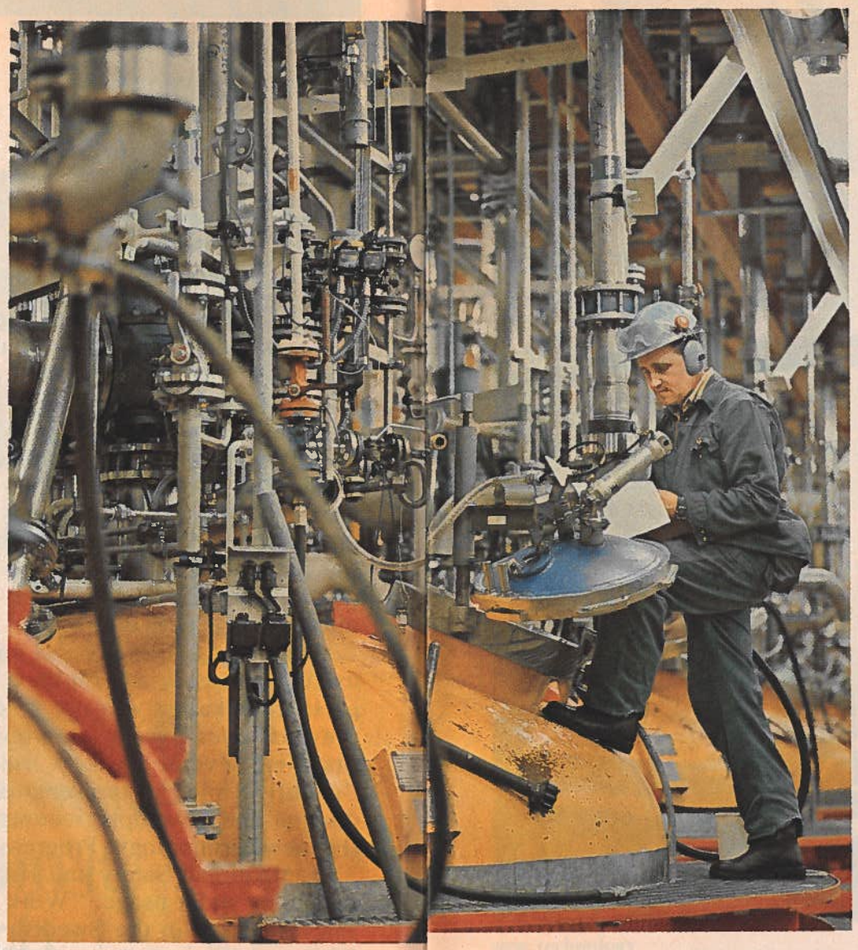
The September meetings in Stockholm and in Jönköping will be held in a country where the forces of nature are under control, and politically Sweden is also not very exciting. We have had time to develop a very good cooperation between labor, management and government in the field of the working environment. This puts a very special responsibility on us to support the good work of the international bodies responsible for promoting and standardizing the working environment and to spread information about what is said and done.

Bertil Delin

KemaNord

Overcoming hazards a question of will

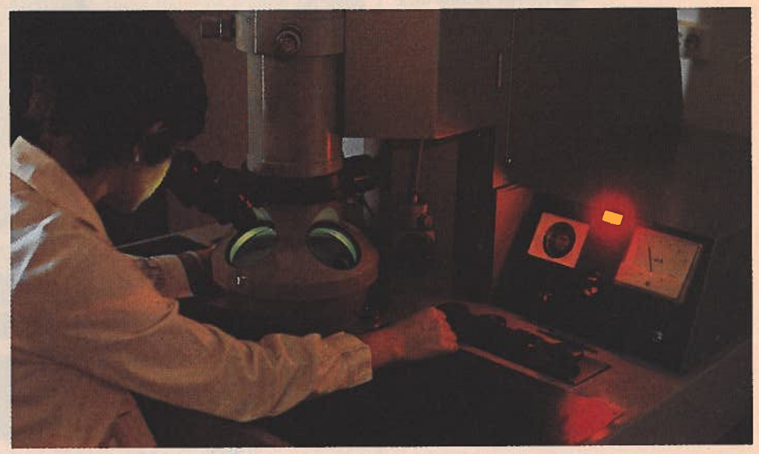
PVC is only part of the KemaNord production at Stockviksverken. There are actually four production divisions, a service function and laboratories. The other three production lines are industrial chemicals, resins and special chemicals.



The dangerous vinyl chloride is changed – polymerized – into polyvinylchloride, which is harmless, in this big container.

Text and photos: Ann-Charlotte and Birger Viklund

Laboratory work is an essential part of the routine at KemaNord. The company has had to go in for new high quality products. It cannot compete with the standard qualities made in other countries with less stringent safety standards.



□ Altogether KemaNord is Sweden's largest chemical concern with a turnover of 1,8 billion kronor in 1976. It has its own water power stations and factories in 10 different locations. The production ranges from candles (Liljeholmens) to dynamite and ammunition (Nitro Nobel, Gyttorp). 7,000 people find employment with KemaNord.

Four cancer cases

It was in the spring of 1974 that a search for the existence of liver tumors led to the detection of two cases of angiosarcoma of the liver. On March 20th, 1976 a third man died at the age of 64 of hemangiosarcoma of the liver. He was employed as an autoclave operator from 1947 to 1968. The tumor disease was asymptomatic until one month prior to the death.

Again in May of this year a fourth worker at the KemaNord Stockviksverken pvc plant died. The provisional autopsy says angiosarcoma. All of the four workers were employed at the time when no TLV was in force and nobody knew about the cancer hazard. The standard only covered the risks of explosion.

Need for international standards

The unofficial permissible concentration for VC was 200 ppm TWA until April 1974. Then a temporary TLV was set at 20 ppm at an 8 hours' time weighted average with 50 ppm as a ceiling. In October 1974 the 1 ppm TLV with a ceiling of 5 ppm for a 15 minutes' TWA was set. It was argued at the time that such a low value would be an impossibility and that it would not be necessary.

The story of KemaNord, Stockviksverken, shows that the new TLV is not only feasible, but possible to attain with a combination of traditional techniques and changes in the production process.

The costs, however, are considerable, especially to reach the very low levels, mainly due to the need for extra staff to service the monitoring equipment. However, the pvc production is a good example of the need for international standards to keep industries from competing with each other at the expense of workers' lives ■

But safety measures costly

"If it had been enough to come down to 2 parts per million, the cost would have been almost negligible. But we had to come down below 1 ppm and the cost rose rapidly to 8 million at Stockviksverken alone. We could have done quite a lot to satisfy other pressing environmental needs with the extra millions". Christer Sjölin, technical manager of pvc operations at KemaNord, looks as if he really means that the extra millions would have been available had the vinyl chloride TLV been easier.

□ There is hard systematic engineering work and a large scale monitoring system behind the present 0,2–0,5 ppm exposure at the plants of Sweden's only pvc producer, KemaNord. KemaNord is also monitoring the outer environment. Some 5,000 measurements had been made over a 6 month period, when we visited the Stockviksverken plant, and only in 77 of these cases were there measurable exposures.

The extra investment costs to KemaNord, including both the Stenungsund operation and Stockviksverken, to manage the very high standard have been some 20 million kronor. How does KemaNord then manage in the competition? "Well, we export very special qualities and manage to stay alive that way. We could never compete with the standard pvc qualities made in countries with TLVs of 10 (most EEC countries) to 50 ppm."

International standards–start with vinyl chloride

The scientific evidence of cancer risks at very low exposure levels is common knowledge all over the world, and to the KemaNord management it is quite astonishing that the same evidence can lead to such different standards as shown by the table.

"If the ILO is the agent for setting international safety and health standards it is high time that something is done. A start could be made with vinyl chloride, where all necessary evidence is available."

All the investments necessary to live up to the vinyl chloride standard at Stockviksverken have been charged to the production. When Swedish industries made large "excess" profits in 1974, the finance minister ordered 20 percent of the profits to be set aside in investment funds to be used in agreement with the unions. KemaNord had 12 ½ million kronor in this fund, but not a cent was used to take care of the new vinyl chloride standard. Instead the joint safety and health committee decided to invest in personnel facilities, in noise abatement, exhaust ventilation in other facilities than the pvc production and, in engineering, to do away with heavy lifting.

In all these cases the company certainly had already lived up to existing standards and codes of practice. But the joint safety committee is not only concerned about a safe working environment–it wants to move into the comfort zone, to optimize the environment.

38 stewards 800 workers

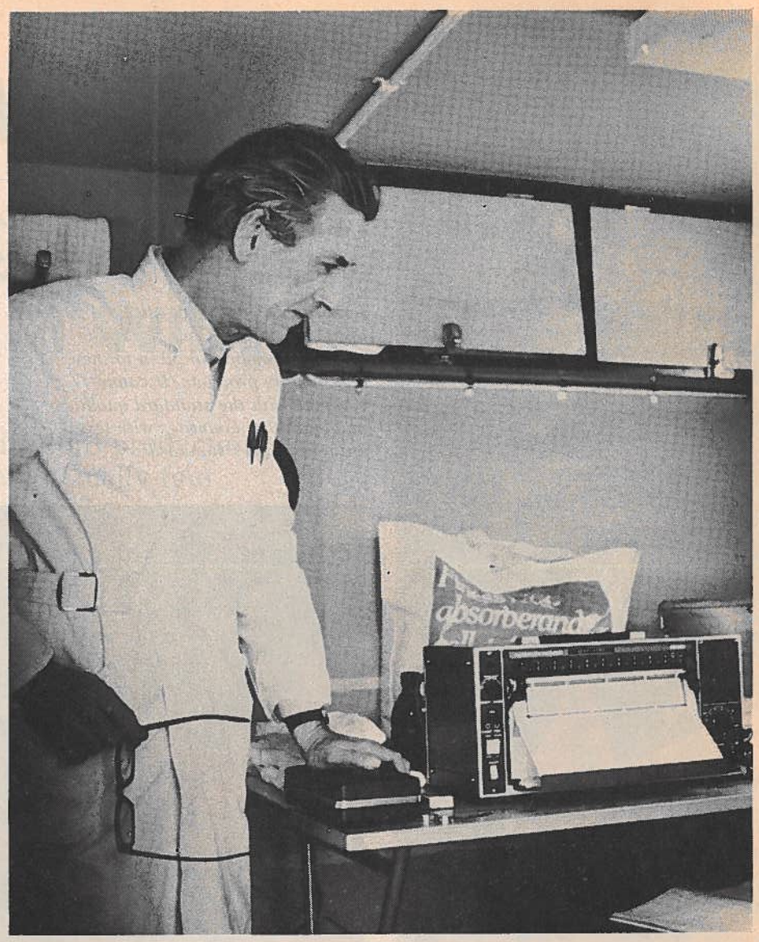
Each production division at KemaNord, Stockviksverken, has its own safety committee. In addition there is a central safety committee, which is also responsible for the overall safety and health function at Stockviksverken, including the ergonomic and medical services.

There are a total of 38 safety stewards for the 800 employees of Stockviksverken–only a few of them have seats in the safety committees, the composition and tasks of which are regulated through agreement between the national unions and the employers' federations.

"We had had very active participation in the safety committees of the pvc plant ➧

Threshold limit values for vinyl chloride in different countries

Sweden	1 ppm TWA 5 ppm (15 minutes TWA)
Denmark	1–5
USA	1–5
Finland	5–10
Norway	Best available technique
UK	25–50
W Germany	5–15 annual average new plant 10–30 annual average existing plant
Netherlands	10
Italy	50
EEC countries	5 new plant 10 existing plant (proposal)
Switzerland	10
Japan	2
Soviet Union	12
Australia	25–50
Canada	10–25



Five thousand measurements in the outer environment have been made during a six-month period, but only in 77 of these cases were there measurable concentrations of vinyl chloride.

and of the other production facilities here when the cancer alert and the ensuing publicity came", says Bengt Sandin, chief safety steward of the Stockviksverken facilities.

"There are 3 management representatives and 4 safety stewards in the plant committee and they all had a thorough knowledge of the hazards and had participated in deciding about the measurement strategy. The safety stewards could explain the situation to their comrades and thus avoid panic–even though mass media panicked."

Worker majority

The "local" safety committee meets formally–according to the agreement–at least 4 times a year but in reality much more often than this, both formally and informally. The central safety committee at Stockviksverken also meets 4 times a year in formal sessions. It has a larger worker majority than the local committee: management has 3 delegates, the manager, the personnel director and the safety director. The blue-collar workers' union has 4 delegates, 3 safety stewards and the president of the local; the white-collar workers' unions, the engineers in SIF, and the foremen in SALF, have one delegate each.

The company physician and the safety engineer sit in at the meetings. But theirs is an advisory expert role and they do not participate in the decisions.

Codetermination for safety

The central committee decides about the budget for safety and health. The costs are, of course, more or less fixed by circumstances like the wages of the medical staff, the safety engineers, etc,–but some amount is also at the disposal of the committee to be allocated by majority vote, if necessary. A large amount for the company health care facility comes from the health insurance–the doctor is supposed to spend some 50 percent of his time on preventive ergonomic work and is paid for this by the company. The 50 percent curative work is paid for by the national health insurance.

"The safety steward in a chemical plant like Stockviksverken needs a lot of education to be able to participate in the decision making", says Bengt Sandin. We all – safety stewards, deputies and foremen, some 200 of us – have read the new basic course, Bättre Arbetsmiljö (a better working environment), and in addition to this a number of us have had education for special functions."

"If they have a reasonable suggestion", says Christer Sjölin, the production manager, "and it is technically feasible, each division has authority to satisfy the demand."

"We are now running specialized courses in chemical health hazards and noise abatement–follow up courses after Bättre Arbetsmiljö–to be able to benefit from the reasonably liberal company policies", says the chief safety steward. "We certainly want to participate in decisions now that we are invited to do so." ■

How KemaNord solved the vinyl chloride problem

By Christer Sjölin, technical manager of pvc operations at KemaNord

□ Vinyl chloride, raw material for polyvinyl chloride (PVC), has been handled in Sweden since 1945. Production of PVC has since 1945 gradually expanded to about 125,000 tons at the two plants of KemaNord, at Stockviksverken and Stenungsund.

Vinyl chloride is a condensable gas with a boiling point at −13°C, atmospheric pressure. For a long time vinyl chloride was considered to be innoxious, apart from narcotic effects at high concentrations (>70 000 ppm). At the end of the sixties, it was found that vinyl chloride at high concentrations could cause changes of the finger skeleton (Acrosteolys), and in January 1974 it was shown that vinyl chloride could cause a very rare form of liver cancer (Angiosarcoma). In contrast to vinyl chloride, the final product polyvinyl chloride PVC, a white powder-like material, is quite harmless.

New routines new technology

When the risk of cancer caused by vinyl chloride was known, KemaNord undertook a lot of steps in order to reduce the concentration of vinyl chloride in the working areas. All work to reduce the concentration of vinyl chloride was done in close co-operation with the staff and the local joint safety committee.

The main points in the abatement programme were the following.

1 Measuring problems
2 Ventilation problems
3 Installation of best technical equipment
4 Technical changes of the process
5 Other measures
6 Medical examinations

The measuring programme covered a very careful investigation of the plant in order to find all possible sources of discharge, so that measures could be taken at the right place. Methods were developed to measure the inhaled concentration of vinyl chloride a worker was exposed to during an 8 hour working day. Furthermore, continous alarm systems in the working areas were constructed in order to warn the employees if the concentration of vinyl chloride should exceed a prescribed value at a certain place.

High chimney built

First of all there must be a good ordinary ventilation system. Secondly, the fresh air must be free of vinyl chloride. For that reason a high chimney was built to guarantee that air containing vinyl chloride could not come into the fresh air inlets. At the same time different types of directed ventilation and spot ventilations were installed.

The technical equipment was systematically checked through the whole process and the tightest possible equipment was installed. The whole waste water system in the plant was rebuilt in such a way that vinyl chloride could not go backwards up through the floor drains. Different kinds of process equipment were also installed, such as high pressure water-jet, anti-foamer etc.

New PVC qualities

The process technique is perhaps the most important one. The aim has been all the time to close the process cycle by recirculation of maximum quantities of vinyl chloride, and convert it into polyvinyl chloride (the desired product).

In order to make it possible to close the process cycle KemaNord has been forced to develop new qualities of PVC, new routines to run the process, and also to buy new technology from other companies.

Among *other measures* can be mentioned that of providing the staff with personal protective equipment, which means that today every employee is carrying a protective mask, to be used in case of temporary vinyl chloride leakages. New operation routines have been introduced in order to prevent worker exposure to vinyl chloride.

Medical examinations started parallel to all technical measures. A very comprehensive medical examination was made of all people coming in contact with vinyl chloride. The medical examination was completed by an epidemiological examination of all people employed at any time by KemaNord in PVC-production in co-operation with the Swedish Board of Occupational Safety and Health and the Swedish Employers' Confederation.

The union involved

In all questions concerning vinyl chloride there was a very close co-operation between the workers and the company, as well as between the authorities concerned. The local safety committee took an active part in the work and solved several practical as well as psychological problems.

Another important problem that turned up in connection with the vinyl chloride issue was the sometimes very emotional discussions in the press, which were not in all aspects quite objective. The information problem caused very great difficulties to a rather unexperienced engineering staff, and unfortunately took very much time.

Satisfactory results

The concentration of vinyl chloride has, however, been reduced step by step from a mean value of about 30 ppm in April 1974 to a mean value of about 0.2–0.5 ppm in the second quarter of 1976. The investment costs for KemaNord to solve the problem with vinyl chloride are calculated to be about 20 million Sw.Crs. Here should be added the work of its own staff and greatly increased operating expenses. The limiting factor in the measuring programme has been all along the lack of experienced engineers.

The problems that still remain are to prevent potential risks and to prevent discharge due to the human factor. Furthermore, much work must be done to improve the process and the process equipment. Compared to our competitors the production costs have increased, but in the long run it is a strength for KemaNord to have solved the problem with vinyl chloride.

To summarize, it can be said that there is much to be learned from the problem with vinyl chloride. It is only because of the fact that vinyl chloride causes a very rare liver tumour, that the carcinogenic effect of vinyl chloride was ever discovered. ■

More safety and comfort —a challenge to engineers

By Gideon Gerhardsson

The technical control of air pollution at places of work follows three main rules:
1. **Stop the creation and discharge of pollutants**
2. **Stop them from spreading throughout the premises**
3. **Stop personal exposure—protect workpeople from contact with pollutants.**

□ Until quite recently, the third method has prevailed in Sweden as in other industrial countries. It is commonest in laws and regulations. It is also followed when places of work are supervised or inspected. Much attention has been devoted to personal protective equipment. Workers are usually obliged to use such devices. Efforts to control air pollution are usually based on hygienic threshold limit values. These stipulate the permissible exposure of a worker to each health hazard at places of work.

However, society is working out new aims nowadays, in Sweden as elsewhere. One of the most important is to create the finest working environment possible. This includes subjective factors—comfort, a feeling of well-being, pride in work, in short, a satisfied mind in a satisfied body.

This broad aim is a mighty challenge to engineers and scientists. They must redesign industrial processes and methods, so as to stop pollutants from being created and emitted at places of work or outdoors. A second part of the challenge is to work out emission limit values. The authorities must then issue the necessary regulations. These will fix the maximum permissible amount of each health hazard that may be discharged from each spot source or each unit of area. A third part of the challenge is to save energy. In cold countries, heated air can be cleaned and re-circulated, instead of being discharged outdoors. This saving can compensate for much of the extra energy that is often needed to stop pollutants from spreading into the permises. A fourth challenge is reliability. All systems for removing pollutants must be very reliable, whether ventilators, filters or control gear for automatic regulation.

A new attitude

Sweden is making great efforts to stop the production and discharge of pollutants into working premises. The subject has been studied in several projects paid for by the Swedish Work Environment Fund. This article gives examples of the results.

Everyone knows that harmful pollutants are discharged into the air at many places of work. The problem is an old one. But the attitude to it is changing. Previously, these pollutants were regarded as unavoidable—a defeatist attitude. In some cases, limits were imposed for emission, but they were based on the *best techniques that were available at the time*. This "best-technology" approach did not stimulate independent technical research and development (R & D) that had the total elimination of pollutants as its main aim. New processes were announced from time to time as emitting less pollution. But the reduction was almost always the by-product of another kind of research, aimed at something quite different, e.g. to boost yield, or quality, or to replace an outdated technology.

All the recent developments in industrialized and urbanized areas are forcing people to change their attitude. The new trends are largely due to growing worry about health risks, especially the ones magnified by the mass media. The old mentality of accepting health hazards at work is being replaced by a more positive, aggressive attitude. In one branch of industry—nuclear technology—enormous sums have already been spent on R & D to eliminate health hazards at work. The public is beginning to demand that workpeople must also be protected from other kinds of hazards, expecially chemical hazards, *which must not be allowed to enter the working environment.*

Team research —advanced methods

This concept brings a new kind of occupational health research. It needs experts that are specially trained in industrial hygiene and ergonomics. They must form part of a team. Other experts in the team must analyse aspects of production, cost and the energy that will be needed. In Sweden, the Work Environment Fund has granted large sums to such team-research projects. First, laboratory and pilot-scale tests are run. Then the new methods are tested full-scale. This is done in industrial plants, with the full cooperation of the employees. This approach avoids many teething troubles when the new technique is adopted more widely.

No Pollution—Low Energy—High Reliability

Modern Swedish industrial hygiene seeks to combine the above three requirements. The aim is to devise new technical systems that allow no pollutants to escape, or only very small amounts, use very little energy, and are highly reliable. Various approaches make the task somewhat easier. They include theoretical models and matrices. A matrix is a kind of table, with places to fill in known facts, and other places for unknown ones. With the help of computers, many possibilities can be tested fast, easily and cheaply, without having to build actual equipment.

As far as possible, the desired environmental requirements are expressed in the form of emission figures (e.g. milligrams of a certain substance discharged per hour). Right at the beginning, the experts select very low values for the amounts of pollutants. They fix them low on purpose, in order to compel the creation of radically new technical methods. As a rule, existing types of equipment do not allow reductions that are big enough.

Save energy!

However, we cannot ignore all of the existing plants—there are enormous numbers of them operating in the world today. It will take many years of tremendous effort to reduce pollution at all these places of work. Great technical know-how is called for, as well as very large investments. There is another major difficulty. Better industrial hygiene at these plants often needs more energy.

Before the oil crisis, managements did not worry much about saving energy when drawing up their cost estimates. For example, rails were abolished in Swedish underground mines at the end of the 'fifties. Diesel trucks were introduced. They boosted the output of ore. But they compelled better ventilation in the mines. This change-over was possible twenty years ago, since electricity was cheap and abundant. Today, it would be unthinkable, because we must cut energy consumption.

Swedish industries have big bills for ventilation. Mines are greediest—30 megawatt-hours per underground worker per year, i.e. 30 000 kwh! Iron and steel works come next with 10—30 Mwh per worker per year. Engineering industries use up to 10 Mwh/worker/year.

A study has been made of industrial ventilation in Sweden, and the improvements required in the period 1975—85 to meet modern hygienic demands. They called for the investment of at least 30 thousand million Swedish kronor. (This equals about U.S. $ 6,800 million, or £ 4,000 million, for a total population of just over 8 million people). What about the energy to run all this extra ventilation?

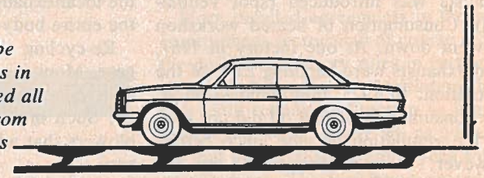
Abolish exhaust gases in automobile repair workshops:

(*Source:* Work Environment Fund of Sweden. Summary No. 45, Reports for 1976)

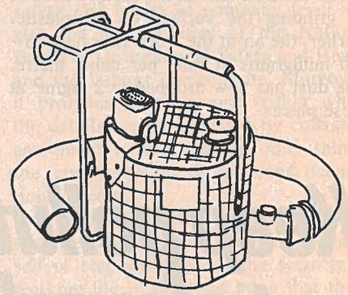
Suggestions if vehicle moves under its own power:

● *Better general ventilation for entire workshop, together with better built-in equipment for evacuating engine exhaust gases.*

● *Mobile evacuation hose that accompanies vehicle wherever it goes.*

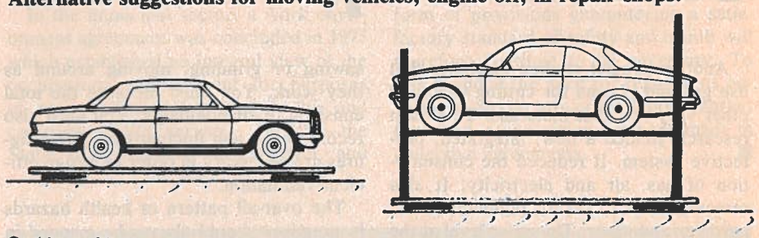


● *Exhaust gases should be evacuated by built-in ducts in floor of workshop, mounted all the way along the lanes from the entrance to the various work stations.*

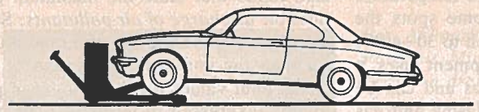


● *Portable unit to be attached to vehicle and connected to exhaust pipe. Eliminates pollutants by catalytic oxidation.*

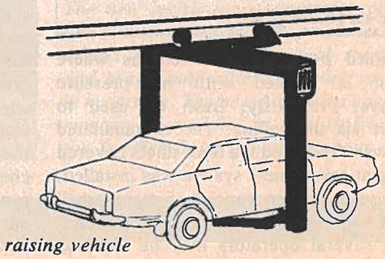
Alternative suggestions for moving vehicles, engine off, in repair shops:



● *Air cushions*



● *Special electric trolley*



● *Overhead conveyor with frame for raising vehicle*

It would be around 2.5 to 4.5 thousand Mwh per year—about the output of a nuclear power plant.

Signs of progress

Improving the working environment therefore includes the task of keeping energy requirements as low as possible. This aspect has been studied in several of the research projects run by the Work Environment Fund.

One project studied the manufacture of plastics reinforced with glass fibre. An advanced system of ventilation by local exhausts was introduced (spot ventilation). Consumption of heated workshop air went down. At one factory in 1967, local exhausts were handling 25 % of the ventilation. In 1975, they handled 90 %. The consumption of fuel oil did not rise, yet the ventilation became much better. However, the electricity used by the blowers rose from 3 to 5 kw per worker.

The dustiest task at the factory used to be grinding the surface of the plastic. Earlier, the air at the work sites held 25–100 milligrams of dust per cubic metre. The dust has now dropped to 2 mg/m³ at these places.

Keep pollutants out of work places!

Another project studied machines that use gas and plasma for cutting steel and other very resistant materials. This team research yielded a new, integrated, protective system. It reduced the consumption of gas, air and electricity. It also removed 90 % of the air pollutants, both particles and gases. The noise level at the operator's site dropped from 95 to 88 dB(A). Ultra-violet radiation was only 1/500 as much as before. Air temperature used to be 60–80°C at some spots the operator had to check. It fell to 30–40°C. This new protective equipment uses a system of standard modules and can be installed on all types of plasma and gas cutters on the market.

Re-circulating air

A third project studied booths where paint is applied with high-pressure sprays. Previously, fresh air used to enter via the ceiling. The contaminated air was exhausted via floor ducts covered by gratings. A new system was installed, using controlled horizontal laminar flow. There were no swirling air currents. Worker exposure to paint fumes dropped by 50 %. Moreover, the new ventilation proved cheaper both to install and to run.

A question that is arousing great interest in Sweden and many other industrial countries is filtering used air and re-circulating it. This reduce the cost of heating premises, a major expense in cold climates. It is easier to work out efficient, economical filters for removing pollutants if they are particles than if they are gases. Various methods are being studied. One is to re-cycle air from the local exhausts. Another is to re-cycle the entire body of air in the premises.

Re-cycling air requires built-in control gear. Monitors must check that hygienic limit values for pollutants are not exceeded. Such monitors can be connected to blowers that add extra fresh air if necessary.

Emission limits . . .

When planning a better environment at work, you must locate *all* sources of pollution. Sources can be highly localized (spot sources) or dispersed. A dispersed pollutant source can often consist of many small spot sources in a given area. For example, several operators may be welding, sawing or grinding, moving around as they work. You must measure the total emission of air pollutants. You must also record peaks and fluctuations. These figures are necessary in order to design efficient ventilation.

The over-all pattern of health hazards in premises should always be mapped in this way. You soon discover an important fact. You feel a great need of emission limits that state the maximum permissible *discharge of air pollutants*. Such emission limit values are often more useful than the conventional system of hygienic limit values for the amount of pollutants (expressed in terms of their concentration in the air which the workers must breathe).

Every place of work tends to have its own particular over-all pattern of health hazards. Mapping them can turn into an extensive job if the parameters are not selected carefully. You must record substances and circumstances that can affect the pattern. They include all biological, chemical and physical factors and aspects. This means a number of measurements for the safety engineer or occupational hygienist. However, many measurements are urgently needed for another purpose, too. They enable long-term epidemiological studies in which exposure is related to small changes in health.

Easier to measure

In general, it is easier to study emission than personal exposure. The amount of pollutants produced by technical processes and escaping into a place of work can be measured and controlled more easily than the amount of pollutants that reaches the worker. The task of making measurements at a place of work can easily swell and become too cumbersome and extensive. To keep this task reasonably small, the occupational hygienist of tomorrow must *focus on eliminating health hazards from the working environment*. This means developing new technical programs that systematically prevent hazardous substance from being created, discharged or spread in the working environment. *The aim is to eliminate pollutants from places of work!*

Such technical control is not possible without extablishing limit values for permissible emission. Working out such limits will cost a lot of effort and money. For emission into the *external* environment, there already exists a number of limits e.g. the discharge from factory chimneys into the atmosphere.

In Sweden today, as in many other countries, the main legal protection for the worker against pollution is that given by the hygienic limit values laid down for personal exposure, or by cumbersome personal protective equipment. Controlling that these exposure limits are not exceeded involves a lot of time, effort and money. If measurements are to be even moderately accurate, highly trained industrial hygienists must do the job. Their equipment is often very expansive. Values are measured in the air which the workers must breathe after all the pollutions from all the different sources have spread out and become mixed.

Controlling emission limits would be far cheaper, quicker and better. It would be done at fixed measuring sites. Equipment would be simplified, so as to record the most characteristic pollutant from each source. Figures would be more reliable. They would be easier to interpret, since they would be gathered at the points where the pollutants enter the air of the premises. Such figures would also be far more valuable to the people in charge of the process. They would yield much more information about the technical conditions of production. ■

The author works for the Swedish Employers' Federation, SAF, as their industrial hygien expert. He is also professor of industrial hygiene at the University of Umeå.

Per Ahlmark:

New targets

In May 1977 the Government presented in the Riksdag a Work Environment Bill planned to become law on July 1, 1978. Compared with the previous legislation on the subject, the new Bill implies a tightening up of the existing regulations concerning the occupational environment and the definition of new and more ambitious targets for efforts to improve working conditions.

□ Current legislation on the working environment is aimed principally at the prevention of accidents at work and of occupational diseases. The new Bill takes in a wider perspective, as witness the following definition of aims, which comes from Chap. 2, Section 1, paragraph (2).

»Working conditions must be adapted to the physical and mental aptitudes of human beings. Efforts must be made to arrange work in such a way that the employee can influence his own work situation.»

A great deal will be required of everyone concerned with the shaping of the working environment if we are to live up to these aims. This applies to employers' associations and trade unions no less than to public authorities, because the new Bill, like the existing legislation, is founded on the traditional cooperation between organizations of employers and employees in Sweden.

This type of cooperation on matters concerning the occupational environment is a longstanding tradition in Sweden. Through their common involvement and as a result of extensive training measures collectively financed by employers, the two sides have accumulated a unique fund of knowledge. It is therefore natural that the Work Environment Bill should to a great extent be based on the idea of cooperation between employers and employees as a prerequisite for the establishment of sound working conditions.

The working environment is primarily fashioned by decision making within enterprises and administrative authorities, i.e. on the spot. The new legislation has therefore been drafted with the aim of establishing guarantees of interaction between employers and employees and, on the other hand, public supervision, with the aim of bringing about sensible measures in the cause of occupational safety and health.

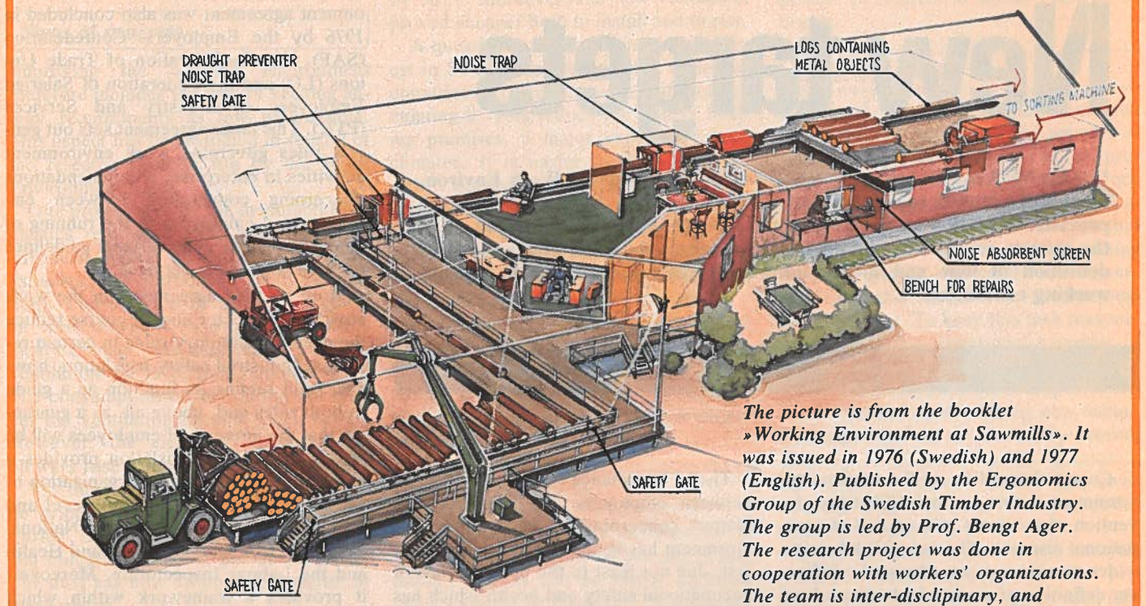
The importance of cooperation between employers and employees on matters concerning the occupational environment has become increasingly manifest, due not least to the broader view of occupational safety and health which has developed in recent years. Legislative amendments which came into force on January 1, 1974 strengthened the position of safety delegates and safety committees and underlined the need for cooperation. Since then, and on the strength of the new rules, associations of employers and employees have concluded agreements on the subject of the working environment.

In the municipal sector, a work environment agreement was concluded in 1975 which established an integral view of the occupational environment for purposes of occupational safety and health and company health services. In 1976 the State, in its capacity as employer, and the main union organizations of State officials concluded an agreement concerning, among other matters, guidelines for company health services. A work environment agreement was also concluded in 1976 by the Employers' Confederation (SAF), the Confederation of Trade Unions (LO) and the Federation of Salaried Employees in Industry and Services (PTK). This latter agreement sets out general rules governing work environment activities in enterprise, recommendations concerning cooperation between employers and employees in the running of company health centres, and guidelines for company health services.

More detailed agreements in the work environment sector may of course reduce the need for statutory rules in certain respects. Industrial safety legislation, however, still retains its function as a guide to both sides and, above all, as a guarantee that the interests of employees will be provided for. The legislation provides a point of departure for the organization of safety and health at company level and also for the activities of the National Board of Occupational Safety and Health and the Labour Inspectorate. Moreover, it provides a framework within which the details can be adjusted by collective agreement to suit, among other things, the circumstances of different occupational sectors.

A framework of this kind is needed for several reasons. Society cannot divest itself of responsibility for the security of working life in the fond hope that these matters will be provided for in collective agreements. Coercive legislation in the form of provisions guaranteeing a satisfactory standard of safety and health will therefore continue to be necessary. To this is added the need for regulations covering those sectors of the labour market for which no provision has been made in collective agreements. ■

Per Ahlmark, leader of the Liberal Party, is Minister of Labour. He inherited a draft bill on the working environment from the previous Labour government. He submitted it to Parliament with minor changes only.
The new legislation guarantees continued interaction between employers, unions and the occupational safety and health authorities, Ahlmark says in his article. The new Act with a commentary is available in English from the Swedish Department of Labour.



The picture is from the booklet »Working Environment at Sawmills». It was issued in 1976 (Swedish) and 1977 (English). Published by the Ergonomics Group of the Swedish Timber Industry. The group is led by Prof. Bengt Ager. The research project was done in cooperation with workers' organizations. The team is inter-disciplinary, and includes ergonomists, psychologists, doctors, nurses and engineers. They have not only mapped environmental problems at sawmills, but also proposed practical solutions.
The illustrated booklet has 40 pages (A5 format). You may have your free copy (English or Swedish) by writing to:
Committee for Working Environment,
Sawmill Industries of Sweden,
S. Blasieholmshamnen 4 A,
S-111 48 Stockholm, Sweden.

Sawmill of tomorrow

Better working environment

□ Quieter, safer, more comfortable and more interesting work! Lots of light and fresh air! Better timber, with less waste! This type of mill has already been designed. The Swedish team forecast it will be built early in the 1980's. They have gathered proposals from mill workers and experts in accident prevention, job satisfaction, noise abatement, lighting, ventilation etc.

Preview of log department

Each log is lifted by the crane on to the conveyor. It is graded and measured by the operator. Then it enters the machine room. If the detector finds no metal, the log is debarked. Saws trim the round log into a long slab, which passes on to the main saws.

There are three operators in the log department. They are highly trained and proud of their work. Excellent judgment is needed, especially for measuring. So they change tasks once an hour. This keeps them fresh and alert, avoiding costly mistakes.

TV cameras help them to supervise the logs. Chairs are comfortable and easy to adjust. Lighting is excellent, and placed just where it is needed. Ventilation is excellent too, and the temperature is ideal. Windows face north and west. No glare or harsh shadows from sunlight!

Quiet control room

The entire premises are lined with sound-absorbent materials. Operators spend almost all their time in the control room on the left. Noise level is 55 dB(A). If they must go into the noisy machine room (90 dB), they wear ear muffs. Effecient insulation on the middle wall confines vibration and machine noise. Baffles let logs pass through the wall, but stop noise and draughts.

Safety first

Operators can easily warn one another, since the rubber conveyors are quieter than chains. If logs do not lie straight, they can be put right from the level gangway, which has railings and safety gates. Any machine can be brought to a standstill within five seconds. No machine can be started without a five-second alarm signal.

The rest of the mill is equally well planned. All jobs are suitable for women. The health and safety of operators come first. Machines are made to serve people, not vice versa.

Cooperation key to good environment

The booklet states that years of difficult work lie ahead. A vigorous effort is needed to improve working conditions at sawmills. Cooperation is the key to success. Trade unionists and mill workers, machine manufactures and mill owners must work together with experts of many kinds. Then dream mills can come true.

Ingvar Lidgren

Sawmills must be ventilated!

An urgent environmental problem!

By Ingvar Lidgren (editorial staff of Arbetsmiljö)

Sawmill workers in Sweden used to be the victims of draughts and biting cold. Nowadays they are suffering more and more from allergic diseases. These are due to dust and fumes from the saws. Ventilation was neglected when the open sheds were enclosed! But at Elinge Sawmill, dust levels are lower than 1 mg per cubic metre of air. This new mill is at Skärplinge, 100 miles due north of Stockholm. It belongs to the Mälarskog Association (private owners of forest lands in the Lake Mälar region).

□ Sawmills in Sweden used to be open sheds. Always draughty, and usually far too chilly! As time went by, the sheds were enclosed to ward off winds and cold. But sickness did not decrease! New health hazards are afflicting the staff more and more often. Airborne pollutants are the main offenders – sawdust, mould spores, fungicides, oil mist and wood fumes from the machines, and excessive noise.

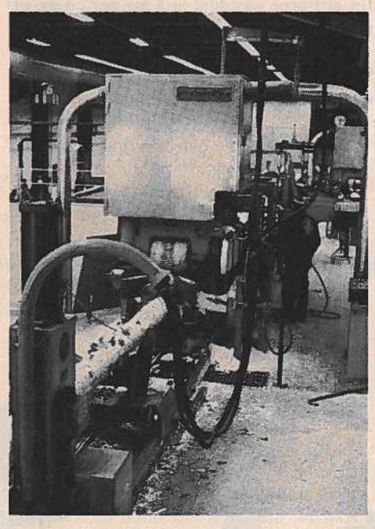
About half of the staff at Swedish sawmills are troubled by dust. In summer, dust bothers 75 % of the staff in sawing and trimming departments. These figures have just been published by the Ergonomics Group of the Swedish Timber Industry.

They did the first inter-disciplinary study of the working environment at sawmills. Moreover, health studies prove ailments of the nose, throat and lungs are more common among sawmill workers than among Swedes in general.

New allergic diseases

»Trimmers' Trouble» is the workers' nickname for one new kind of allergy (»justerverkssjuka» in Swedish). It is easily mistaken for a cold, or for inflammation of the lungs. At the end of the shift, the worker suffers from high fever, headache and aching joints.

Ten years ago, the first cases were reported to the Union of Wood Industry Workers in Sweden. No one knew the cause. We now know that it is due to the spores of a mould that grows on sawn timber being dried in modern dryers. We have also learnt that the mould cannot grow if the dryer is run at 60°C instead of the usual 30°C. This preventive step is not enough. Highly efficient ventilation must be mounted on the trimming saw, to prevent all spores and dust from reaching the operator.



Frame saws fitted with housing. Air pressure inside it is kept below atmospheric by powerful exhaust blowers. Dust and fumes under the machines cannot whirl up into the working premises

Another new allergy is due to the turpentine fumes driven out of wood by the heat of sawing. Workers get headaches and feel sick. This allergy is a direkt result of enclosing the sawmills. The old sheds were so draughty that any fumes soon blew away.

In Scandinavia, logs are often stored in water to avoid damage by insects. The longer this storage, the more fumes are driven out by the saws. The hazardous substances consist of terpenes. So far, no hygienic limit has been set for them. So the only limit we can apply is the one for turpentine – 560 mg per cubic metre of air. Unfortunately, much lower amounts produce allergic symptoms. This is because terpenes have a sensitising effect. Workers become more and more sensitive to the fumes.

Chlorophenol products banned

There is another serious airborne hazard at sawmills – particles and fumes of the fungicides used to prevent blue-staining of the wood. Fortunately, chlorophenols will be banned after 31 Dec 1977. They contain poisonous impurities called dioxins. Moreover, the chlorophenols themselves turn into dioxins if treated wood is burnt.

Even though chlorophenols can be replaced by less hazardous substances, the latter are unfortunately poisonous, too.

Slow, cruel poisoning at sawmills

Eight hours a day, five days a week! You breathe a deadly mixture of sawdust, turpentine fumes, oil mist, fungicides, mould spores . . .

No wonder you feel tired and ill at work! Foul air is one of the worst environmental problems at sawmills.

Solutions

To find solutions, the above Ergonomics Group studied several Swedish mills and factories. The project was led by Anders Söderqvist, an industrial safety engineer. The Group has just published its find-

ings, including recommendations. These are based on advanced systems of ventilation already installed at some mills in Sweden, e.g.

- local exhaust for frame saws
- comprehensive ventilation system for a sawmill
- local exhaust and fresh air supply for a trimming department.

Important discovery

Good ventilation at a sawmill is difficult to achieve. Old mills usually have bad ventilation. But so do many new ones, too. Why? The Group offers an answer. Large volumes of air are stirred up by the moving machinery! This façt has been ignored by all the ventilation experts! The Group proved a frame saw »pumps» about 700 cu.m. of air per hour down under the machine. Part of this air recoils. Sawdust, oil mist and turpentine fumes whirl up through the entire premises!

Fine example

»Fresh air for every worker» is the proud motto at Elinge Sawmill, 100 miles due north of Stockholm.

The new mill replaced an older one in Nov. 1975. It cost 16 million Swedish kronor, of which 0.5 mkr was for ventilation (U.S. $ 3.55 m and 1.1 m). Annual output of sawn timber is about 40 000 cu.m. on single shift.

About 50 people work there, including office staff. The mill also runs a factory with a staff of 30, who make roof trusses.

The premises are clean, and well-lit according to the latest methods. The working environment is agreeable, apart from the noise. This problem will be tackled at a later date (see below).

Mr Ragnar Sjölin is the engineer responsible for the advanced design. He leads the New Buildings Section at *Mälarskog*. This is a profit-making association of people with privately-owned forests in the Lake Mälar District around Stockholm.

Good working environment through advanced techniques

He says »In the spring of 1974, we decided to build a new mill at Elinge. We wanted it to meet future demands. This meant combining a safe, healthy working environment with advanced production methods.

Right at the planning stage, we concentrated on the problem of removing airborne dust and supplying plenty of fresh air. So the ventilation plant was ready when the mill started up. However, we decided to postpone decisions about fighting noise. We wanted to wait until we had measured noise levels and tried out our own ideas in practice. Then we would decide what anti-noise methods to adopt.

In Sweden, the present hygienic limit for airborne sawdust is 5 mg per cu.m. of air. We aimed at a much lower figure when we planned our ventilation system. It would yield big advantages. Less sawdust means less risk of ill-health and fire, less cleaning, and less wear on important machine parts.

The barking machine and the frame saws were enclosed in housings and fitted with powerful local exhausts. So were the edging saws, the chipping machine and the chip screens. Shavings and sawdust vented in this way are utilized by blowing them directly into a boiler.

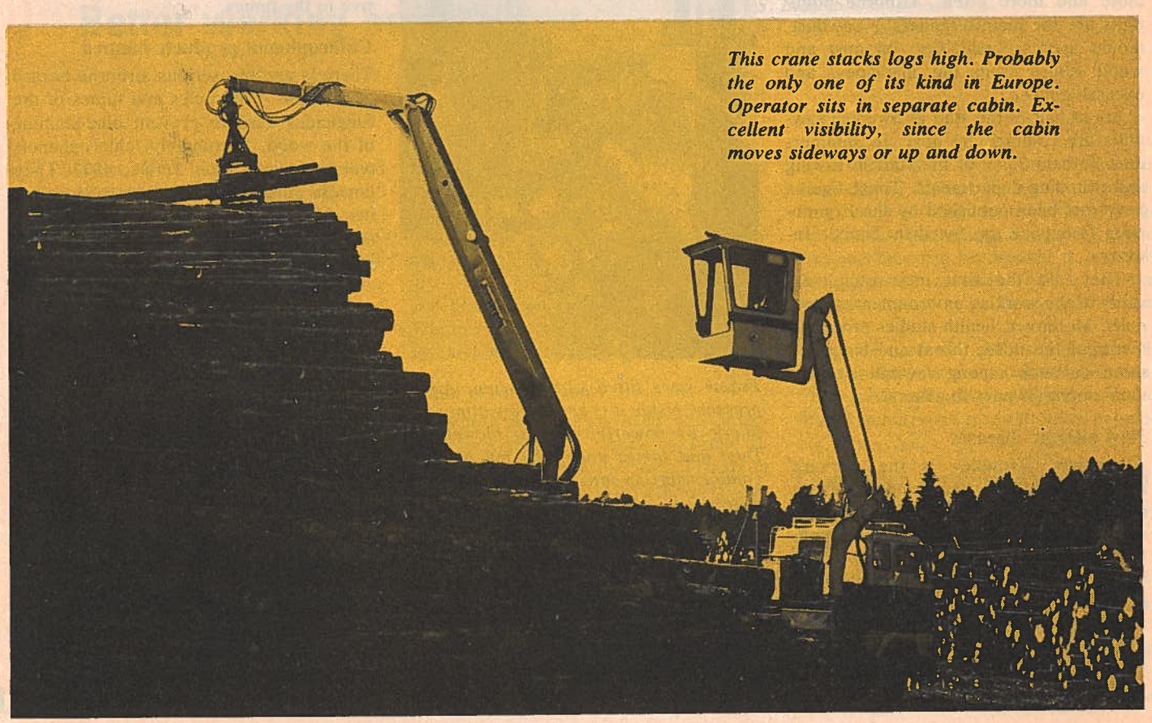
The system enables four modes of ventilation, depending on the climate indoors and outdoors. Automatic control is used. If the premises get cooler than 17°C, air heaters are turned on. In summer, air from outside is blown in all night long. Premises are pleasantly cool next morning.

We also had to consider the heat generated by the electric motors and the machines. It is about 275 kilocalories per hour (320 kw). In summer, this heat must be vented by the blowers» Mr Sjölin concludes.

Less than 1 mg sawdust per cu.m.

The result? Sawdust levels at five operator sites lie below 1 mg per cu.m. A higher figure was found at one place only (1.4 mg per cu.m. at the barking machine). Measurements were made by *Ergolab*, an independent firm of consultants.

»A magnificent result» says Mr Inge Karlsson, the mill workers' delegate for safety and health. We are very happy about the fresh air at our mill! I haven't had any more complaints about allergy!» ■



This crane stacks logs high. Probably the only one of its kind in Europe. Operator sits in separate cabin. Excellent visibility, since the cabin moves sideways or up and down.

Wood trimmer's disease from moulds on planks

Lars Belin
Bengt Wallentén
Kjell Wimander
Sahlgren's hospital and YMC Göteborg

Mould spores are almost always present in the air, but their number and types vary with time and day, weather, season, location and especially with man's activity in various occupational situations. Moulds easily grow on plant materials of various kinds, such as hay, grain, fluor etc and in agriculture the inhalation of large amounts of mould spores is known sometimes to cause pulmonary allergic reactions of an inflammatory, influenza-like type (by clinical immunologists classified as a type III immunocomplex reaction). The reaction is a consequence of our immune system which in these cases is causing rather than preventing disease.

□ Briefly, our immune system is necessary for life because it provides defence of our biological integrity. Two important functions are connected with this defence system, namely: 1) recognition of foreign organic material entering our body and 2) amplification of other defence forces to defeat the potential intruder. Unfortunately the battle always has to be fought on home ground and this can result in much tissue damage.

During the last fifteen years several occupational mould type III allergies have been recognized, particularly by a very active group headed by Professor Jack Pepys in London. Farmer's lung is an often cited example of this type of allergy, but similar reactions have been described among malt workers in Scotland, cork workers in Portugal, mushroom pickers in Germany, maple bark strippers in the U.S. and so forth.

Fever reactions

During the last two years we have recognized a similar allergic reaction in the trimming department of Swedish saw mills. The identification of this allergic disease has resulted from a joint work between The Clinical Immunology Laboratory at Sahlgren's Hospital, headed by one of us, and others–industrial physicans–who have primarily seen the cases.

One of us in 1974 noted a health problem in the trimming department of a saw mill situated in the northern part of Sweden. There was an increased rate of illness, particularly fever reactions. There had been previous claims about the use of fungicidic chlorophenols because of their toxicity, but the intereting thing was that the fever reactions seemed to increase in frequency half a year after the cessation of chlorophenols in the working area. The affected workers could correlate their reactions with the occurrence of moulds on the planks processed in the trimming department. From dust collected in the working area various moulds were demonstrated in abundance by our microbiologist, Dr. Per Wåhlén. Various antigenic test reagents were prepared from the most common moulds by techniques known to be particularly successful in other similar situations at our laboratory. Immunologic testing of the serum fraction from blood of the affected six individuals was done by means of these test reagents. In these "precipitin analyses" serum and test reagents diffuse against each other in an agar gel. Since antibodies in the serum precipitated (fell out) together with the test antigens in the gel, thereby forming precipitation arcs, there was reason to suspect that a similar precipitation could occur in the lungs and cause the workers allergic reaction.

Headaches, coughs

The workers were also subjected to skin tests with mould test reagents. The affected workers turned out to be skin test positive more often than their non-affected colleagues but again we could not by objective testing predict exactly which were the symptomatic and which the asymptomatic cases. The clinical history, which was revealed partly by the use of a questionnaire and partly by individual interviews, indicated that four of the affected workers had had the fever attacks combined with headache, cough and general malaise between 12 and 8 times during the two previous years while two workers had experienced five or less occurences of the reaction. Some of those with the most frequently occurring attacks were so affected that they had lost weight and had developed an increased sedimentation rate.

The results just described were reported at a Scandinavian meeting arranged by the Swedish board of Occupational Safety and Health in Uppsala 1975 and the allergy, named by us "wood trimmer's disease" has also been described at other occasions.

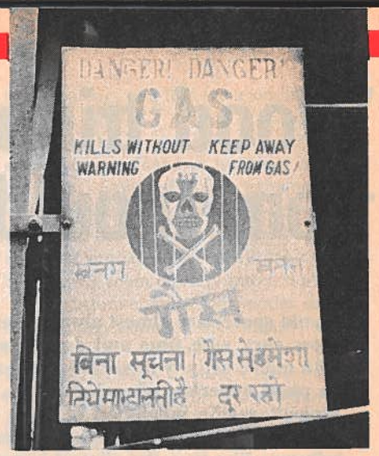
The information collected at the Clinical Immunology Laboratory, Department of Allergy, Sahlgren's Hospital, in Gothenburg now tells us that wood trimmer's disease is a widespread medical hazard and an organized investigation of the problem has been made in a wood district of the southern part of Sweden. Here six modern trimming departments have been studied by clinical interviews and serological analyses. We have also started to quantitate the number of mould spores per gram of dust or m^3 of air in the working areas. With certain variations we have found precipitins in some 70–80 % of the workers at all 6 different trimming departments while symptoms which we have ascribed to the allergy have occurred in some 10–20 %. The precipitating antibodies are directed in a typical fashion to the mould species isolated from the dust. In order to trace the mould infection of the wood timber Dr. Hans Lundström at The Department of Forest Products of The Royal College of Forestry has started a special program to make analyses up to the critical point of the processing of the wood, namely the large buildings where the planks are artificially dried by heated air.

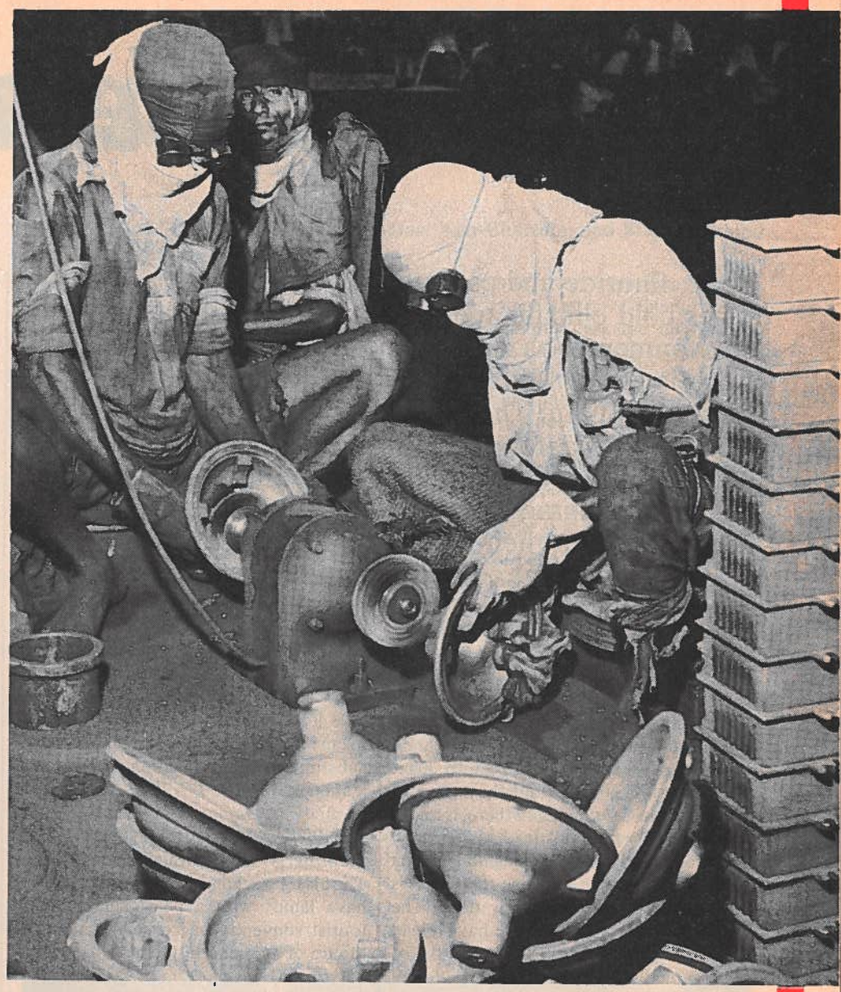
Dark patches

For yet not quite clear reasons, very favourable conditions sometimes arise for the actual moulds which then grow in abundance on the surface of the sawn planks. Here they have an excellent sugar rich substrata, and on photographs the mould can be easily seen as dark irregular patches.

Our finding of Rhizopus and Paecilomyces as the most dominating moulds has been confirmed repeatedly, although certain variations in the pattern can occur. These moulds are exceptionally thermotolerant and we have in time accumulated an increased knowledge of why they can generate spores in such large amounts in the trimming departments. A very intense outgrow of mould can occur during the drying, which is the process preceding the handling of the planks in the trimming departments. Trimming, sorting and packing is effected by mechanical transportation of the planks on conveyer rollers.

Recognition of this medical problem in Swedish saw mills has resulted in transfer of affected workers to other working areas but also in constructive information and discussions with the technological experts who are now urged to find out means by which mould growth is prevented during the processing of the wood. ■





It takes two men to lift a load onto one man's back. A classic of the ILO list of conventions is the maximum weight standard for one man's burden. The ILO safety and health program, PIACT, also includes assistance in the fields of research and training.

No one life is cheaper...

The pictures show a poster warning against accidents at the Jamshedpur steel plant, a lecture at the Bombay physiology institute in how to measure stress-strain relationships in a steelworker, Tata steel mill and an obsolete method of cleaning castings.

□ There are several factors that must combine harmoniously for the creation of a good working environment: full employment, free trade, active forward-looking work environment research and development, quick translation of research into new standards with participation from unions and employers' organizations, international coordination of the high safety standards, well-staffed safety and health administrations and inspectorates, high quality safety and health staff in the plants, genuine, well-educated and strong trade unions, and imaginative employers and employer organizations.

By international comparison Sweden and the other Nordic countries have a fair measure of all these factors.

While it is true that investments in an improved working environment usually contribute to a more efficient production and, therefore, are self financing, new high standards can on occasion prove to be costly and can price a production out of the market, if competitors are not forced to observe the same standards.

Standard improvements in one country might, therefore, just lead to the export of jobs, if there is no international coordination through international conventions, and no codes of practice and exchange of practical experience. It would therefore seem appropriate to tie GATT to the development of international standards of safety and health under the ILO.

Less than full employment is the single most vicious enemy of a safe, healthy, humane and inspiring work environment. A worker, who risks losing his job by pushing for an improvement that his employer cannot afford, is a poor ally in the fight for a better working environment. The best government support in the struggle for a better work environment may be an active industrial and manpower policy, that guarantees education for a better and safer job when the old one becomes obsolete, unproductive and unsafe.

There has been a tendency for employers to run away from new standards by exporting the obsolete and unsafe production facilities. And labor has tended to seek protection from imports from these facilities through tariffs. Rather than protectionism, the answer to these problems is, of course, free trade and international standards. Cheap flags of convenience in the field of shipping are yellow flags. This also goes for the cheap flags in the field of asbestos fabrics and pvc and in the production of other articles that have recently come under strict safety rules. Granted, countries in different stages of economic development must be able to compete with one another in terms of labor costs. But safety standards and TLVs are absolutes. No one life is cheaper than the other.

It is no coincidence that the work on a new occupational safety and health act in Sweden has taken place simultaneously with the laborious work of writing a new collective bargaining act. The common characteristics of the two acts are advanced forms for codetermination. The emphasis is on workers' participation at the place of work – making the worker a master over his immediate work environment and involving his union in the planning of the total work environment, work organization and production.

No less should the worker be involved in research that is carried out on his behalf to improve the work environment. Research support by the Swedish Work Environment Fund is notable for the great number of tripartite steering groups and reference groups that are set up to see to it that the research becomes useful and worker centered. The new Swedish quality of work center will go even deeper into work organization and psycho-social matters, bringing life into the paragraphs and letters of the two acts.

This special issue of the house organ of the work environment family in Sweden, of elected safety stewards, foremen, safety engineers, and industrial health workers will try to describe the Swedish work environment model: cooperation instead of adversity.

Birger Viklund

Birger Viklund, general secretary of the ILO symposium on air pollution in the working environment, Stockholm 6–8 September, is guest editor of this international issue of Arbetsmiljö.

Lead, fluoride, asbestos —glass industry hazards

Lead, fluoride and asbestos, along with hot and at times cold climate and draught, are the great environmental hazards in the glass industry. Lead is an ingredient in the raw material in the form of minium. The large glass works in Småland, Kosta and Orrefors have 30 percent lead in the batch of raw material that is heated up to 1400 degrees centigrade in the ovens. Reijmyre has 24 percent lead in their batches. Finnish glass works do not use lead at all but zinc, which is not dangerous to the same extent.

Text and photos: Ann-Charlotte and Birger Viklund

□ It is in the batch room, i.e. the room where the raw materials are mixed in a batch from different bags and containers, that the workers are exposed to lead. The exposure is measured through continuous blood samples. If there is more than 70 micrograms of lead in 100 milliliters of blood it is reaching the danger level, and it is time to move the workers or have them rest for a few days. The two batch mixers at Reijmyre have a lead level in the blood that is just below the so far accepted TLV of 70.

Lead silica not dangerous

The joint raw materials plant for the entire glass industry, proposed by the study of the work environment of the glass industry and by the minister of industry, would serve to eliminate the lead exposure. A pelletized raw material for the individual glass mill would be less dangerous.

But while the politicians are planning a joint raw materials plant, the British producers have developed minium into harmless lead silica, and as a result the workers who have been in the danger zone can literally give a sigh of relief.

Reflection and brilliance

Lead is used to give glass more reflection and brilliance. It would be possible to get the same effects by replacing lead with zinc or barium, and it would be possible, as has been done in other countries, to hermetize the process in a system that would bring the raw materials right into the oven.

Thus, there are several technical solutions for managing the new TLV whether it may be 40 or 50 micrograms, and even if it is combined with a maximum allowable lead content in the ambient air. The means would be, to use tecnical terms, substitution, hermetization and rationalization.

The pearl lamp of the castle

Fluoride is used to dim the light bulbs. The king's chandelier is supposed to have lamps with a pearl band. On the tourist souvenir, an ice bear standing on the tip of an iceberg, the bear has a pearl color while the iceberg is brilliant glass. The part of the souvenir that has to be dimmed is lowered into a container of fluoride. The lamp is painted with a dark color except where the white strip is supposed to be. The fluoride attacks the silica in the glass to make it white.

There is no TLV in Sweden for fluoride. We only know that it makes bone harder and brittle and prevents caries. However the National Board of Health and Welfare has published instructions to the effect that if there is more than 4 micrograms of fluoride per liter of urine in a man, something has to be done to stop the exposure. The normal fluoride content in urine is 0,5 micrograms per liter.

Asbestos gone

When we visited Reijmyre we dove right into a bargaining session between the manager and the chief safety steward about what could be done to lower the fluoride exposure in the very special work process we have just described. Exhaust ventilation and extra sanitary facilities have been arranged – very much seems to depend on personal cleanliness – but the fluoride content in the urine of the operator is still alarmingly high. Let's continue to keep the operator under medical observation, and let's consult available medical expertise, is the consensus. It would be good also, the two parties agree, if the National Board of Occupational Safety and Health would say something about fluoride.

Asbestos was used earlier in the conveyor belt for the hot glass products on their way to the annealing lehr. There has been wear and tear on the conveyor belts made of asbestos, and asbestos dust has been found in the air. Now this hazard is eliminated. The old conveyor belts have been replaced with a new transport system.

Hot and smoky – but pleasent

The heat from the ovens in the old mill is the great problem during the summer months. Temperatures of 70 degrees centigrade have been measured. The necessary fresh air brought in through open doors and windows lead to draught. But the glass blowers probably accept the negative sides of the "Glass House" if that is the only way to keep the atmosphere, the wooden bars in the ceiling and the jacket nonchalantly hung over a chair in the vicinity of the work bench . . .

You cannot explain the absentee statistics in any other way: absenteeism is high, up to 15 percent, in the new part of the mill where the heat resistant glass is made, but very low in the old smoky environment. Here we can also discern a generation gap: the old glass worker used to have two breaks, half an hour around ten o'clock and three quarters of an hour around one o'clock. Since work begins at six, the worker was still home by 3:15.

In step but out of rhythm

Now the young people with a minute majority have forced through two four-hour stints with one break of 45 minutes.

"It's too American for my taste", says the chief safety steward. To work for 4 hours at a stretch is too heavy, the old rhythm was better.

"The absenteeism in the heat resistant department has to do with the two-shift system that is worked there. Often up to four of the workers fail to turn up in the afternoon. They are young people who have difficulties both in starting at 5:30 and in working very late in the evening, when they have the late shift. But after all, this is a continuous process, and we all know how expensive energy has become. And it is going to become even more expensive."

No piece work

Reijmyre knows no piece rates, the workers are all on time rates. The impression is that the production flows evenly and harmoniously, even if some of the tasks may seem monotonous – like lifting glasses into the annealing lehr one after another after another after another in a never ceasing stream for eight hours . . .

The wage spread seems tolerable from the point of view of equality and a wage policy of solidarity: of the four men in the gang – it is called »workshop» in Reijmyre terminology – the youngest earns 20:81 kronor an hour, the blower makes 22:26, »the leg maker» 24:29 and the master 25:47.

The turnover in the labor force is minimal:

"If the father works in the mill, we usually try to find a job for the kids also, if they are interested when they leave school."

The safety steward has a political role

"We are relatively lucky here at Reijmyre compared to several of the Småland mills", says Hilding Andersson, chief safety steward, "because we don't have to work while they fill the ovens. This is done during the free shift, which means that we can avoid the heat and the vapours that are let loose during the filling procedure."

"The grinding facilities used to be in the glass house. Now we have separate rooms for the grinding operations and plenty of space. It is hard to imagine that 50 years ago there were 300 workers in the glass house, blowers and grinders together in cold, cramped conditions. They used to die of tuberculosis . . ."

The chief safety steward is also a member of the environment committee of the municipal council, but in this function he has no problems with the glass mill:

"The lead coming from the grinding operation is under control both in the plant, since we now only have wet grinding, and in the outer environment. We take care of the sewage water and purify it. However, this is a very small problem here at Reijmyre since the grinding operations are small. It's a larger problem in the Småland glass works."

"The smoke from the oil we are burning is a bigger problem. You can see the soot on the manager's mansion across the road! But still this is not too big a problem, since we burn only oil with a low sulphur content. The glass does not take kindly to sulphur."

"But I do worry about the other factory here at Reijmyre. They use cyanide, which we know can kill anybody, in their guilding operation. And think of the metal plant in the Finspång center. They let go of lots of cadmium into their river . . .".

Industrial health center coming

Modern times have come to Reijmyre also in the form of discussions about an industrial health center, which is to have its headquarters in the Finspång center some ten miles away from Reijmyre.

Large companies have their own services, but in this case the idea was to involve the county and the hospitals in a pilot project with support from the Work Environment Fund.

But it was not possible to have the unions and the county agree about services and finances. Instead the municipality and the enterprises in the area will now set up a conventional health center according to the principles in the agreement signed between the trade union federation, LO, and the employers' federation, SAF.

The new health center will service some 2,500 employees in small enterprises all over Finspång. The costs to the employers will be some 300 kronor per employee per year. The new center will be able to give all the medical and ergonomic services that we have grown to expect from institutions of this kind which is staffed with medical doctors, safety engineers, ergonomists, physical therapists, nurses and, some day, also psychologists. ■

Heat, draught and chemicals are the hazards in the "glass house" of Reijmyre. But Håkan Olsson, master in the workshop, gets a lot of satisfaction out of his job.

Specialize the glass industry! Invest in new techniques!

□ The joint batch factory, where raw materials are mixed and pelletized to be sent to the individual glass works, is not the ultimate solution to the problems of the small glass works, says Lennart Rosén, manager of the Reijmyre glass works.

The mixing of the raw material is just one of several environmental problems concerning only just a few of the employees. Besides, this problem could be solved in any number of other ways.

The heat and wasted energy in the mill is a greater problem concering all of us. So the government assistance should rather be concentrated in the area of finding technical solutions for creating energy saving ovens, and tanks. Today only 10 to 20 percent of the total energy spent by the glass industry is actually spent in making glass – Reijmyre only burns 3,000 cubic metres of oil a year – the remainder is wasted and contributes to making the working environment unpleasant, especially in hot summer months.

Sigvard Skarström's grinding job is now "wet" and less dusty.

Artificial resuscitation

Up to now the government support has mainly contributed to preserving a hopeless structure. The dying glass works have been kept alive by means of artificial resuscitation, and their sales have contributed to killing competing glass works which would otherwise have managed.

However, Reijmyre still supports the new government program for the industry. If it is combined with product specialization and export promotion it will serve to improve the working environment and make the industry more profitable.

Heat resistant glass

So far Reijmyre has managed quite well and may serve as an example for the whole industry. The National Board of Technical Development, STU, has given technical support in the development of a speciality, heat resistant glass, which you find only in Reijmyre of all the Scandinavian glass works.

For efficiency in the export field Reijmyre has become a subsidiary of GAB to be able to offer a complete home- and restaurant line, Table Top.

GAB includes GENSE, making cutlery both in silver and stainless steel, and HALLBERGS, selling jewelry and precious metals in a chain of stores all over Sweden and through an export company in the US. This way Reijmyre through GAB is becoming an alternative to Rosenthal instead of mainly competing with other glass works.

Work for Silvia

Today the small hand glass works in Sweden can no longer compete with the giant glass factories on the continent in the field of restaurant glass. Machine-made glass, Duralex, is by far cheaper and on occasion even better. The hand-glass-works must go in for specialities and short orders if they are to survive.

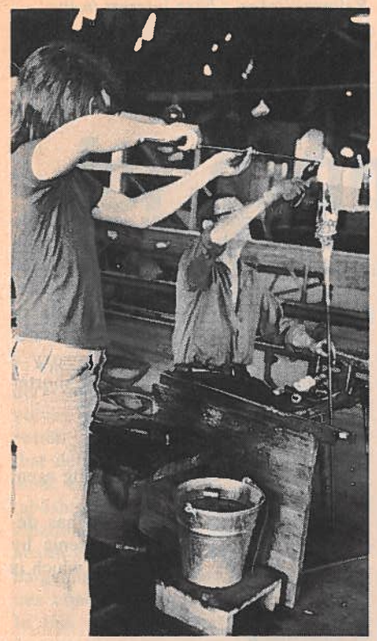
Thus Reijmyre makes lamps for the king and the queen, complimentary souvenirs for Volvo and other export companies, earlier made specially designed glass for the prime minister's residence, Harpsund, during Olof Palme's days, and makes itself available when the world's oldest joint stock company, Stora Kopparberg, wants to renovate their crystal chandeliers.

The Swedish glass industry has a foundation of skills inherited through generations. With modern design and inventiveness it will survive this structural crisis – if we are to judge by the Reijmyre example. But there is room also for a techincally advanced glass machine for making wine and other drinking glasses in this country, says Lennart Rosén, in the same way that PLM makes bottles in a machine. Today the restaurants – once the largest customers of the glass works – buy all their glasses abroad.

Follow the Finnish example

"But let's not invest in more ovens for heat resistant glass just because we have managed in that field," says Rosén. Other glass works must find their specialties. For us, competition with the German factories in Mainz is enough.

A sensible division of labor between the glass works, as they have done in Finland, is necessary if we are to continue to export about 40 percent of the production. The government support should be the instrument of planning such a division of labor rather than attempting to keep a lopsided structure alive through artificial resuscitation. ■



Per Olofsson helps Karl Gustav Svensson, the leg maker, attach a leg to the glass vase.

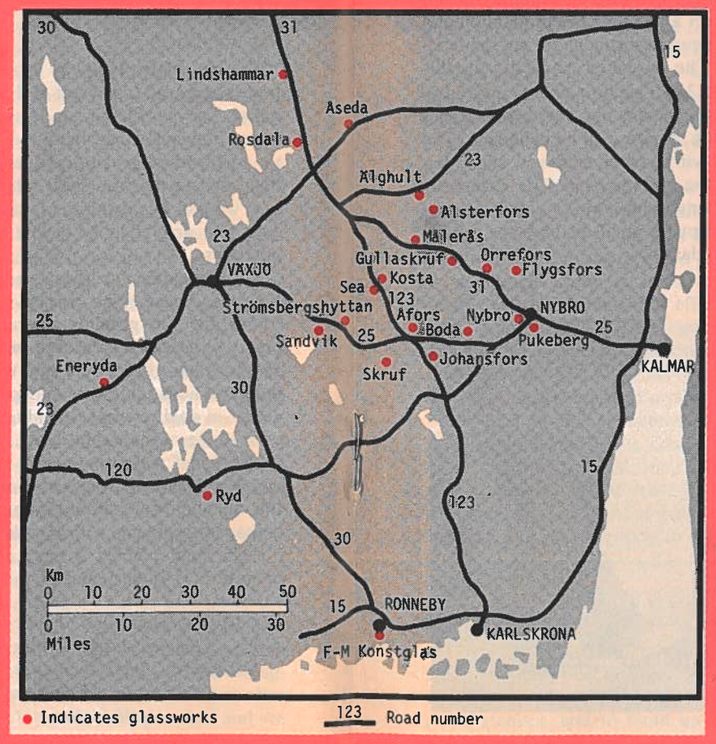
Industry survey shows seventy chemicals in glass

By Lars Arvidsson, occupational safety and health advisor to the Employers' Association of the Swedish Glass Industry.

□ In Sweden there are 30 glassworks, employing about 3,000 workers, manufacturing handmade glass. The size of the works varies from 15 to 700 employees. Working methods are traditional to a very great extent, and it is a general impression that a wide spectrum of stress factors persist in the working environment; noise, heat, heavy and monotonous work, polluted air. A thorough survey of working conditions was carried out in 1975–76. The study was sponsored by the Swedish Work Environment Fund (ASF) and undertaken jointly by the Employers' Federation of the Swedish Glass Industry and the Swedish Factory Workers' Union. A project committee employed specialists for the surveys and for measurement and analysis. A report was published suggesting protective measures in the production units. This led to a number of continuing development projects, such as "elimination of asbestos through material substitution".

One of the special tasks was an investigation of the exposure of workers to chemical raw materials and to airborne particulates, gases, and vapors emerging from

Handmade glass-souvenir of Sweden



□ In May of this year Parliament voted 25 million kronor for a three year period in support of the Swedish manual glass industry. Over half the money will go towards investments in equipment to improve the working environment mainly in the batch mixing area and around the ovens. Other forms of support are in the area of technical training, service from consultants from the National Board of Industry, and export promotion. Rationalization, mechanization and structural change are well in line with artistic values and high quality, the minister said in introducing the bill.

Outside of this 25 million kr program the government promises 8 million in a location-of-industry grant and an amortization free loan towards a joint batch plant for the glass industry, a solution to the health hazards from exposure to lead in the mixing chamber of the small glass works. The total investment in such a factory is 15 million kr, and the government support is on condition that all the glass works cooperate.

In addition, the glass research institute has substantial government support according to an agreement between the institute and the National Board of Technical Development, STU. The research mainly concerns materials technique and production technique.

Earlier in the 1970's the glass industry received around 18 million kronor in government support in the form of export promotion, training, and aid towards structural changes in the industry. In spite of all this, the industry is suffering from international competition, mainly from factory-made glass. The structure of the Swedish manual glass industry has not lent itself to quick changes.

In 1950 there were 60 glass works in operation with a total of 4,000 employees. Today these figures are reduced to thirty glass works organized in twelve companies employing 2,300 workers. The industry is geographically concentrated in the district of Småland, the classical small industry center of Sweden. Some 40 percent of the production is exported, mainly to the United States. In 1974 the total export earnings were 84 million kronor. They are increasing by some 15 percent a year. ■

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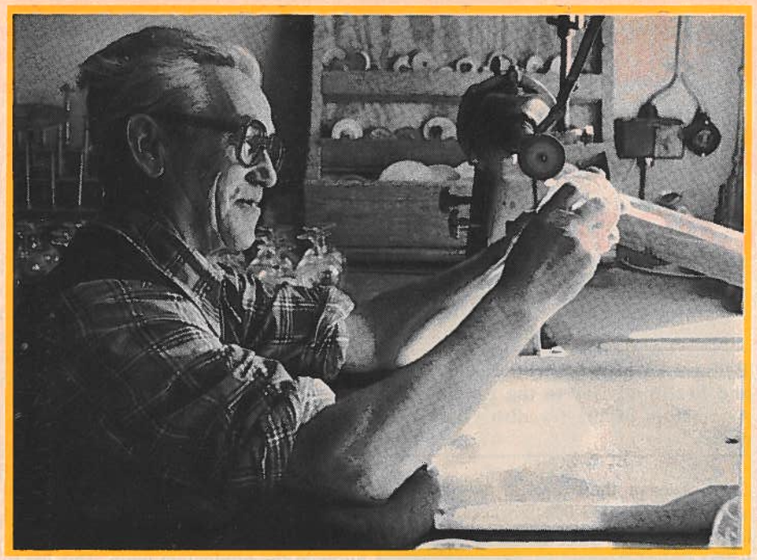


Reijmyre takes a keen interest in the individual worker. Henrik Oppelt, a Sudeten-German immigrant from Zwickau has a room of his own where he adorns the glass with scenes from his native Bohemia.

them. The responsibility for this job was given to the Swedish Glass Research Institute in Växjö. Data were collected from all glassworks on their annual consumption of all kinds of raw materials. The figures were summed up in a list. It was concluded that 70 different chemicals are in use, a number which can be regarded as relatively small. The greatest volumes are sand (10,000 tons/year) and soda (2,300 tons/year). Of minium (Pb_3O_4) 140 tons and of arsenic 130 tons are used annually. Metal compounds such as the following are used for coloured glasses:

- Antimony Oxide (Sb_2O_3) – 05, tons
- Chromium Oxide (Cr_2O_3) – 0,05 tons
- Selenium, metal (Se) – 1,3 tons
- Cadmium Sulfide (CdS) – 2,9 tons
- Neodymium Oxide (Nd_2O_3) – 1,7 tons.

Airborne particulates in workplaces were investigated thoroughly. The following data were registered:

1. Total inorganic dusts and fumes
2. Lead emission
3. Arsenic emission
4. Time distribution of emission levels
5. Number of persons exposed during consecutive working hours.

Production in the glassworks is arranged batch-wise. Raw materials for one batch are mixed in a mixing room and filled successively into melting furnaces in the glass house. The melting is watched over by team A. The melted plain glass is taken out in clots which are wrought by team B. Teams A and B work in different shifts.

There is a relatively small risk for the larger team to be exposed to excursions above STLV (Swedish Threshold Limit Value). However, regular compulsory medical examinations on blood lead and urine lead (ALA) show that glassblowers to some extent are exposed to excessive levels of airborne lead. The melting team, usually 1–4 workers, is exposed to levels significantly above permitted values. A variety of methods are now being tested aiming to reduce exposure levels.

a) Ventilation

The melting process takes place in oil fired pot-furnaces, in which melting-pots holding 300–400 kg are placed. Filling or charging is traditionally done with shovels from mix troughs through the 16–20 inch wide doghole. In doing this the worker is exposed to melting gases, emerging directly towards the worker's breathing zone. Evacuating hoods around the doghole lessen the emission.

b) Filling machines

The heavy work of filling sand mix into melting-pots with a shovel can be eliminated. A mix holder is placed on a truck fitted with a water-cooled vibration feeder. The heavy work and the inhalation of gases is considerably reduced. As a safety precaution the worker must carry a fresh air mask during the now shorter filling moments.

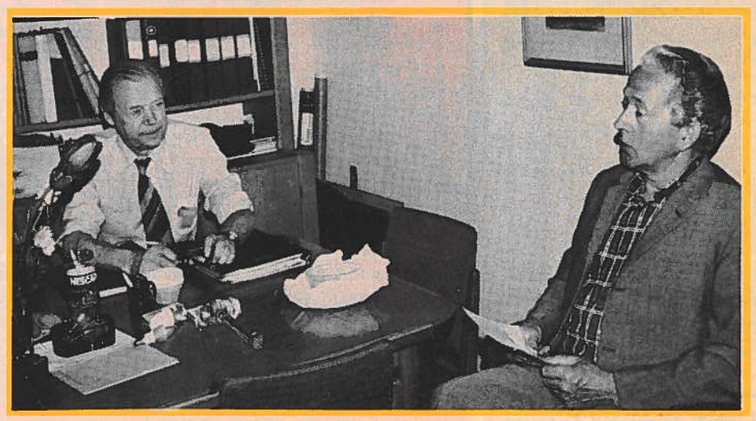
c) Exchange of added chemicals

Arsenic trioxide acts as a planning agent during melting.

The Glass Research Institute has developed methods to replace arsenic by antimony trioxide, the STLV of which is tenfold that of arsenic trioxide.

d) Pelletizing

Pelletizing means transforming the loose material mix into granules or pellets. The method has been adapted to glass technology by the Glass Research Institute. The pellets generate much less dust and can be transported without the ingredients separating. The technical advantages are faster melting and reduced loss of metal oxides. Practical experiments have shown that airborne lead and arsenic fumes are considerably reduced. The Swedish glass industry has jointly decided to erect a plant for the production of a standardized assortment of raw material mixes. The intended capacity of this plant is 13,000 tons of pellets and 6,000 tons of loose mix per year. All batches containing minium will be pelletized. The material will be received in new silos adjacent to the glass houses. The hazardous batchmixing in glassworks will be eliminated except for small batches for special kinds of glass. ■



Lennart Rosén, manager, and Hilding Andersson, chief safety steward, discuss what to do about the fluoride problem.

Worker participation for optimal environment

By Eric Bolinder, medical advisor of the Swedish Trade Union Federation, LO

□ One of the fundamental values of modern democratic industrial societies involves the demand for employee participation in the process of making decisions that determine the basic features of the work environment. Thus, legislation establishes general guidelines for the participation of employees in plant-level health and safety work, and collective bargaining agreements between the parties concretize these guidelines further. In this way, the primary responsibility for the character of the work environment is laid on the parties, locally at the plant level. It is in this context that efforts to improve the work environment become a question of *optimization* rather than simply a question of stopping as soon as minimum demands are met.

Prior testing of chemicals

Insofar as the question of airborn contaminants–as an example of a problem in the work environment–is concerned, let us try to analyze how these optimization goals can function within the framework of a network of legislation and of administrative measures in such a way as to assure that the individual worker has the best possible assurances for safe working conditions during an entire working lifetime.

The first demand which must be met is to control the flood of chemicals entering the workplace. We must pass legislation which requires producers and importers to test such products in advance for health and environmental effects. We must have an effective government agency which concretizes these demands and which has the authority to prohibit, authorize or control such products.

We must be able to require labelling of such products, including complete statements on the chemical composition (including impurities) of trade name products and the provision of material safety data sheets which are easy to understand for those who are responsible for them at individual workplaces.

Only when the agency has in this manner gathered a clear picture of what chemical products are present in workplaces is it possible to set priorities for efforts to attack individual substances and groups of substances, and to build up effective routines for control. This system must also be able to collect information based on experience out in workplaces, as well as the knowledge which continuously comes in from national and international research.

Practical standards

Standards, in the form of threshold limit values (TLV's), are a necessary instrument in the panoply of measures aiming at a safe work environment.

TLV's must be set with great care, and they must reflect not only scientific criteria but also practical and economic ones. If the agency sets TLV's on its own–without participation by the parties–this can create a good deal of anxiety among employers and employees, and often produce debates which degenerate into theoretical battles far removed from the world of practical reality where the system is, after all, supposed to function.

We have today all too many industrial societies where there is a considerable divergence between the ideals expressed in TLV regulations and the conditions actually existing in workplaces. The process of establishing TLV's can be divided into three phases. The first phase involves setting priorities for which substances one wishes to establish TLV's.

The second phase is a scientific evaluation of dose-response curves, where one attempts to determine the degree and the nature of different effects on man of different dose levels.

The third phase involves the final determination of exposure limits, where known and suspected risks for man must be given primary consideration, but where other factors must also be weighed in.

Limiting the scientist's role

The role of the scientist should be limited to presenting, in the most objective manner possible, the effects of exposure at various dose levels.

Unfortunately, it is all too common that scientists extend their role to include weighing in technical and economic value judgments, and to delivering as the end product of their work a recommendation for a certain, definite exposure limit.

In my view, a scientist who does so goes beyond his area of expertise. The end product of the scientific determination phase should, in my view, be a well-documented report with *alternative* exposure limits, where the consequences of these alternatives from a toxicologic and medical viewpoint are explained.

During this stage it is important that labor and management are able to follow this work through their medical and industrial hygiene experts, so that they can report on the scientific discussions to the sides they represent.

Voluntary compliance desirable

It is in the third phase–the final establishment of TLV's–that the very difficult decisions are made about how other aspects shall be weighed in. During this stage it is extremely important to attempt to bring about a decision upon which all the parties–the agency, labor, and management–have reached agreement. If one is successful in attaining unanimity through cooperation, possibilities of a completely different order open up for obtaining voluntary compliance at the workplace level.

Possibilities of a different order are also opened up for planning production changes on a long-term basis.

This way of going about things also allows one to avoid the complications which otherwise occur when a government agency makes a decision in isolation. This could produce a situation where one or the other party involved puts decisions on TLV's into question, urges the agency to recondiser TLV's previously decided upon, and in this manner takes agency policy off a steady keel, with all the consequences for unsystematic priorities in agency activities, and poorly planned investments for industry, which this implies.

In Sweden, the local safety committee is given a central role in this regard. It is there that any questions relating to the work environment as it impinges on the company's planning and operations should be discussed. It is there that goals, both long-term and short-term, should be formulated.

Where the real job is done

The safety committee, which has a worker majority, is also the organ responsible for company medical services.

Especially in the area of chemical health risks, it is essential that decision-makers have at their disposal a staff of industrial hygiene and medical experts, well-integrated into the company structure, who can present the safety committee with all the information they need in order to correctly make a judgement of the health risks which exist. This is why we feel that a company's medical services must have both an industrial hygiene and a medical component.

The responsibilities of the industrial hygiene component of a company's medical services is of central importance. These include finding out exactly what chemicals are being used in the company, and continual plant-level sampling, often involving the use of sophisticated sampling strategies.

Above all, these responsibilities involve participation in the planning of technical solutions – such as substitution of products, encapsulation of processes, ventilation, etc.

Directed check ups

The medical element of company medical services shall function above all as a check on the technical efforts – through directed medical examinations and through catching early signals which indicate that, despite the efforts undertaken, risks still exist in the work environment. In our view in Sweden, company medical services should be seen above all as a work environment-oriented activity. It must be integrated into the health and safety organization in the company, and function in an advisory capacity to the highest organ responsible for health and safety, the safety committee.

For small and medium-sized firms for which it is infeasible to have in-plant company medical services, we have had positive experiences with medical service centers owned and administered jointly by several firms.

In Sweden, we have 170 such centers in operation. They are controlled by a common board, which has responsibilities similar to the safety committee in an individual firm, and which has the same composition.

An interesting solution for a medical services problem in an entire branch is offered by an organization in the construction industry, which has a central unit, regional units, and mobile units at individual construction sites.

How to cover small firms

Such branchwide solutions are being planned at present for the transportation industry and for agriculture.

The many small and spread-out firms which cannot participate in any of the organizational forms just discussed constitute a special problem. We are in Sweden planning an experiment based on the resources we already have available in our health service system. The problem here is to find organizational forms which can meet the demands for integration into plant-level activities and for influence by the firms and their employees.

The needs of company medical services for sufficient resources is also an essential question. This involves both the need for access to more specialized environmental and occupational medicine investigations and access to high-quality analytical resources. Here, we are trying in Sweden to build up hospital occupational medicine departments in our country's various regions. These consist–like the company medical services at the plant level–partly of occupational medicine specialists, partly of industrial hygienists to undertake complex investigations of environmental conditions, but above all also of analytic resources for the needs of company medical services. Since the occupational medicine specialist can function as a referral doctor, it is possible to use the various other specialized departments of the hospital for occupational medical needs–for example, audiology, dermatology, clinical physiology, neurophysiology, radiology, etc.

I have on several occasions underlined the importance of laying the chief responsibility for the work environment on employers, working together with employee representatives.

The will to accomplish something and the ability to function in an optimal way are in significant measure dependent on information and training.

Safety stewards no technicians

We should underline that we have no desire to make safety stewards into environmental or sampling experts. Their job is, together with employers, to act as qualified decision-makers. This means that they need to possess general knowledge about the problems which exist, and general knowledge of details so that they are able to make good use of the government officials and in-plant experts who are at their disposal. In Sweden, we have during these past two years carried out–under the joint sponsorship of labor and management–nationwide training on the work environment, in the form of a basic course on these questions, which has reached practically every plant.

Government inspections can never accomplish more than to give advice and to make sure that the minimal demands the law makes are complied with. Constructive and optimizing work environment efforts must occur based on the commitment and the resources of labor and management themselves.

A joint responsibility

I have attempted to describe a model built on the basic principle that the primary responsibility for the work environment shall lie at the plant level, and that this responsibility shall be borne by labor and management locally, cooperating with each other.

National legislation shall according to this model establish the preconditions for such cooperation and express demands for the work environment in a form which aims towards an optimization. Society must accept the responsibility for providing the resources which are required in order that such work can effectively be undertaken. This means resources in the form of training of the experts needed, as well as the development of adequate research resources. This also means social resources in the form of effective government agencies and institutions for research and analysis.

The government agency becomes in this way not an instrument whose primary function is to check and to inspect, but one whose primary function is to initiate, to advise, and to distribute information and experiences to the individual workplaces they are to serve. ■

Chronic effects of solvents at exposure below TLV

Some recent and current investigations of chronic effects on occupationally exposed workers have attracted considerable interest in Sweden and Finland. First, the very fact that chronic effects may exist today in industry workers may seem somewhat surprising. Secondly, some of the results indicate chronic effects at solvent concentrations well below existing TLVs. In the following will be given short reviews of the studies on house painters (the Department of Occupational Medicine, Regional Hospital, Örebro), on car painters (the Institute of Occupational Health, Helsinki), and on workers exposed to jet fuel at different industries (the National Board of Occupational Safety and Health, Stockholm).

By Bengt Knave

Examples on questions used in the study on exposed house painters and non-exposed industry workers (controls). The percentage of »yes» answers is given.

Questions	Painters	Controls
Do you suffer from chest problems?	44	27
Do you suffer from stomach problems?	35	21
Do you suffer from skin problems?	48	23
Do you suffer from memory difficulties?	46	14
Are you very tired?	39	21
Do you get angry easily?	15	25
Have you been absent from work owing to illness for periods longer than one month?	44	27

☐ **House painters.** Four works have recently been published from the Department of Occupational Medicine in Örebro: (a) a cross-sectional study in which 52 house painters were compared to 52 industry workers (Blume et al., 1975; Axelson et al., 1976), (b) case reports on ten house painters with a »chronic psycho-organic syndrome» (Axelson et al., 1976 a) and (c) a case control study on neuropsychiatric ill-health in workers exposed to solvents, using a regional »register of disability pensions» (Axelson et al., 1976 c) (Case-control study: After initial identification of cases, that is locations of persons with the disease in question, a suitable control group or comparison group of persons without the disease is identified).

The first-mentioned study and enquiry revealed higher frequencies of subjective symptoms in the exposed group. Also when registering absence owing to illness and in some psychometric tests (reasoning capacity and psychomotor coordination) there were clear differences. Ten of the heavily exposed painters were found to have symptoms such as deterioration of memory, personality changes of an asthenic or depressive–aggressive type and abnormal fatigue. This led the authors to suggest a chronic psycho-organic syndrome in these patients. In the case control study on neuropsychiatric illness a relative risk of 1.8 was found with neuropsychiatric diseases among workers exposed to solvents, such as painters, varnishers and carpet-layers, when compared to building workers not so exposed.

Car painters. A cross-sectional study of 106 car painters and 106 locomotive engineers (controls) was performed and included evaluation of subjective complaints, neurological examination, neurophysiological and psychological tests (Husman *et al.*, 1975). The study shows statistically significant differences between the exposed and non-exposed groups which may indicate the presence of chronic effects among the car painters due to exposure to solvents. It should be pointed out that in this study and in the one on house painters it was possible to make a comparison between the present psychological test results and those obtained *before* exposure to solvents by using the results from military enlistment tests.

In the car painters study the solvent concentrations in the respiration air were measured in 54 personal samplings from six garages. The solvents (mainly toluene, xylene, buthylacetate and white spirit) were found, as a mean, in concentrations well below existing TLVs in Finland and Sweden. The total concentration of solvents only amounted to about 50 % of the limit values in Sweden, for instance.

The jet fuel studies

Recently, a number of employees working with jet fuel in an air-craft factory made complaints of symptoms of neurasthenia and polyneuropathy. The exposed workers were examined with neurological and neurophysiological methods and the results obtained were compared with those from studies of different reference groups of industry workers (Knave *et al.*, 1976). The exposed persons were divided into two groups with regard to degree of exposure: a heavily exposed group consisting of 14 persons and a less heavily exposed group consisting of 16 persons. All 29 had been exposed for at least five years of employment.

When the fuel concentration was measured in 1972, before ventilation im- 32

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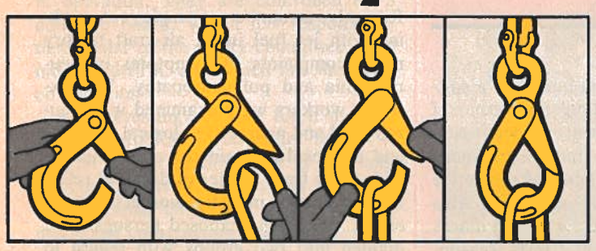

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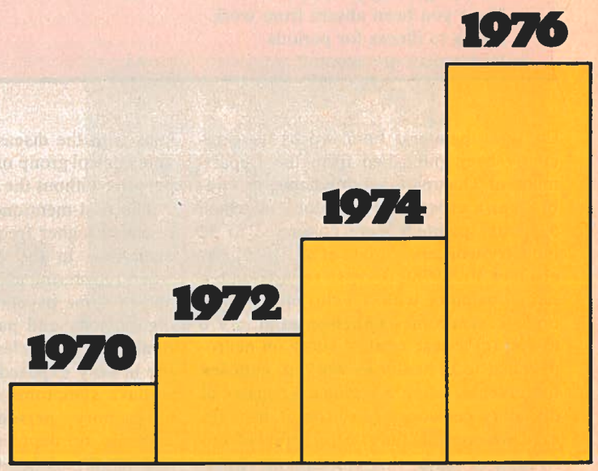

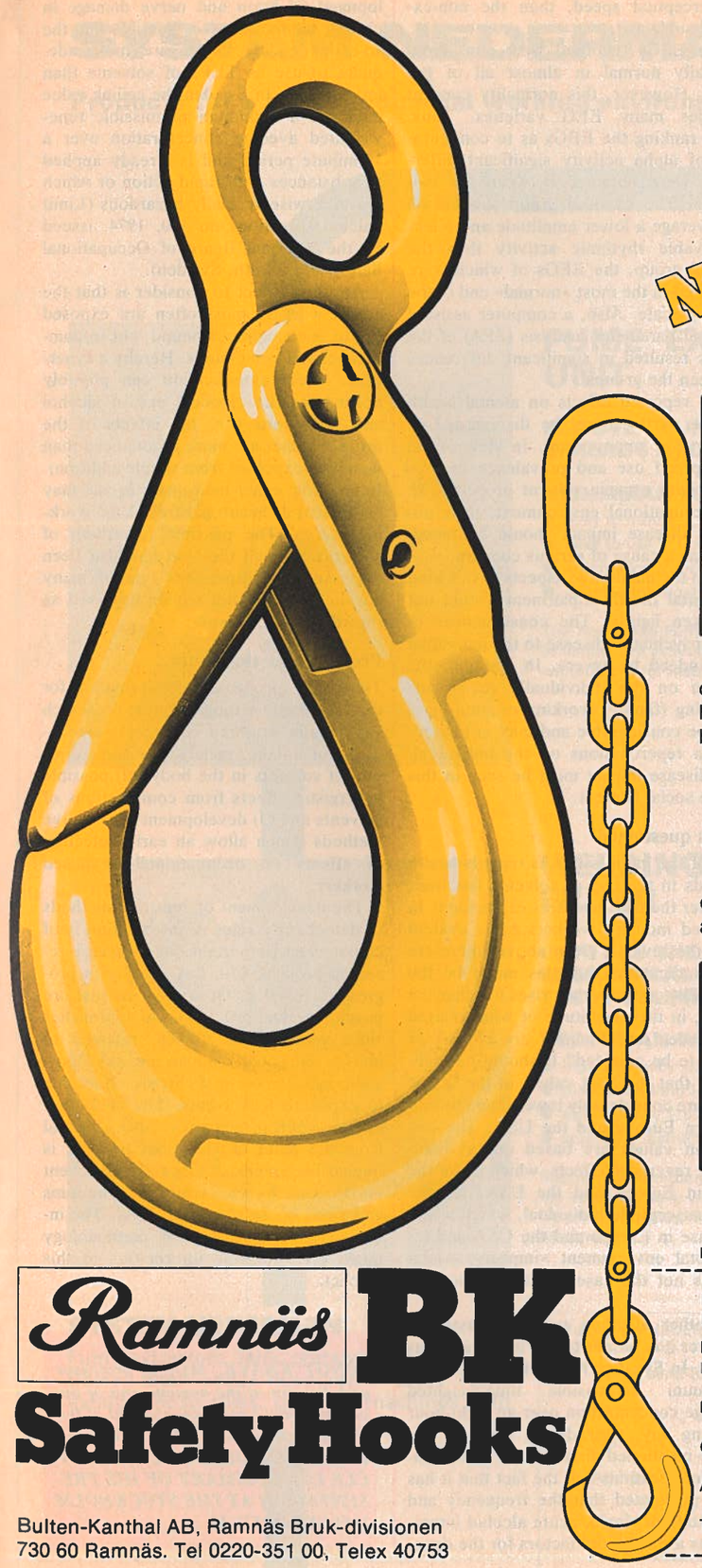

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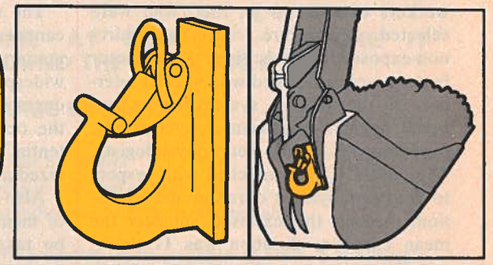

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provements, the results showed 3,100 ppm at one work place and about 500 ppm in two work rooms. All persons in group 1 and seven out of 16 in group 2 stated that they repeatedly had experienced acute symptoms (dizziness, headache, nausea, breathlessness, palpitations and pressure on the chest) on exposure to high concentrations of jet fuel vapours. On such occasions they often had to interrupt their work to »get a breath of fresh air» for release of symptoms.

Fatigue and depression

Quite recently the results from an investigation in another jet motor factory were presented (Knave *et al.*, 1977). Thirty workers exposed to jet fuel, who were selected on exposure criteria, and thirty non-exposed controls from a jet motor factory were examined with special reference to the nervous system by occupational hygiene physicians, psychiatrists, psychologists, and neurophysiologists. The controls were matched with respect to age, employment duration and education. Among the exposed subjects the mean exposure duration was 17 years, and 300 mg/m^3 was calculated as a rough time-weighted daily average exposure level.

All but four subjects in the exposed group reported recurrent acute symptoms upon exposure to jet fuel vapours during work (dizziness, fatigue, headache, nausea, respiratory tract symptoms, palpitations, and thoracic oppression). The incidence of neurasthenia, anxiety and/or mental depression during employment at the factory was significantly higher in the exposed than in the non-exposed group as recorded from medical history and a standardized interview and notations in the medical records of the factory health department. Among the neurasthenic symptoms, fatigue, depressed mood, lack of initiative, and dizziness dominated but significant differences were also found as to palpitations and thoracic oppression, sleep disturbances, and headache.

Psychiatric interviews

The prevalence of mental symptoms in the exposed and non-exposed groups was assessed by psychiatric interviews and ratings. The results show that exposed individuals have a larger number of psychiatric symptoms than the controls. Neurasthenic symptoms showed the largest differentiation between the groups, followed by neurotic disturbances.

In the psychological examination, behavioral performance tests indicated a difference in performance capability between the groups. The exposed subjects had a greater irregularity of performance on a test of complex reaction time, a greater performance decrement over a period in a simple reaction time task and a poorer performance in a task of perceptual speed, than the non-exposed subjects.

The EEGs recorded were considered clinically normal in almost all of the cases. However, this normality concept includes many EEG varieties. Thus, when ranking the EEGs as to configuration of alpha activity significant differences were obtained between the two groups. The exposed group showed on the average a lower amplitude and a less observable rhythmic activity than the control group, the EEGs of which were clustered in the most »normal» end of the ranking scale. Also, a computer assisted spectral parameter analysis (SPA) of the EEGs resulted in significant differences between the groups.

The reported effects on mental health cannot, furthermore, be disregarded as marginal or unimportant. In view of the widespread use and prevalence of products with organic solvent properties in the occupational environment, their potential disease impact should be recognized as a cause of serious concern.

Also the qualitative aspects of this kind of mental health impairment should not be taken lightly. The consequences of neuropsychiatric disease to the individual may indeed be severe. In addition, the burden on the individual's social surrounding (family, working relations etc) may be considerable and may in turn result in repercussions on the individual. The disease impact must be seen in this whole social context.

TLVs questioned

One of the main issues as regards health hazards in the use of solvents has been whether the chronic effect exists today in exposed industry workers.As is evident from the reviews given above, there are clear indications that this might be the case. The question then rises whether the TLVs, in the magnitude of what is used in Sweden and Finland, are correct or ought to be adjusted? It should be mentioned that the limit values in the USSR often are considerably lower than those in western Europe and the USA. The low Russian values are based on (a) functional, reversible effects, which is not the case in Europe and the USA, (b) the most susceptible individual, which is not the case in Europe and the USA and (c) the total environment »impact», which also is not the case in Europe and the USA.

Another question to be discussed is whether it is proper to use level values as TLVs. In Sweden the level value states a maximum permissible time-weighted average concentration over an eight-hour working day. Considering many of the above-mentioned findings on acute solvent intoxications and the fact that it has been postulated that the frequency and amplitude of single, acute alcohol intoxications are essential factors for the development of brain and nerve damage in chronic alcoholism, it is possible that the so-called ceiling values are more adequate to use as TLVs of solvents than level values. In Sweden the ceiling value indicates a maximum permissible time-weighted average concentration over a 15-minute period and is already applied to substances with rapid action or which are otherwise specially hazardous (Limit values. Directions no 100, 1974, issued by the National Board of Occupational Safety and Health, Sweden).

Another aspect to consider is that the actual workers most often are exposed not to one single compound, but to combinations of compounds. Hereby a synergistic effect amplification can possibly occur, like the classical one of alcohol and barbiturate (i.e. the effects of the drugs together are more pronounced than would be expected from simple addition). In addition, other neurotoxic agents may be present as health hazards at the working places. The possible resorption of solvents through the skin has also been discussed and represents one of many questions which still remain unsolved as regards the TLV issue.

Prospects for the future

To provide proper basic information for the standard settings, future research should aim at three issues: (1) mechanisms of uptake, metabolism and excretion of solvents in the body, (2) possible synergistic effects from combinations of solvents and (3) development of sensitive methods which allow an early detection of effects on occupationally exposed workers.

The development of sensitive methods to detect early signs of intoxication is of course very important, and several research projects with this aim are in progress in Sweden. Of special interest are psychiatric and psychological approaches since one of the studies, referred to above, indicated a »chronic psychoorganic syndrome» as a chronic effect due to exposure to solvents. The methodology research in general is also essential from the point of view that today it is impossible to make a diagnosis of solvent intoxication by characteristic symptoms and signs on an individual level. The increased efforts in issues of methodology might give valuable information in this respect.

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More to dynamite than sudden death

Christer Hogstedt and Olav Axelsson, medical doctors and researchers at the Department of Occupational Health of the Örebro regional hospital, have found that nitroglycerine has a number of long term effects so far not observed because of the more dramatic »sudden death», in Sweden called »dynamite sickness».
The Örebro scientists have studied the register of deaths and burials in the parish around an explosives factory and have found a considerable excess mortality in ischemic heart diseases and in cerebrovascular diseases among men with long time exposure to explosives.

NITROGLYCERINE-NITROGLYCOL EXPOSURE AND THE MORTALITY IN CARDIO-CEREBROVASCULAR DISEASES AMONG DYNAMITE WORKERS

□ Nitroglycerine was introduced into medicine in 1847 and has been subjected to a great number of investigations from the pharmacologic and toxicologic points of view. Nobel and associates showed some interest in the toxicity aspects but it was not until the 1930's that more thorough investigations were made (Crandall 1933). Also during that decade the serious effects of nitroglycerine-nitroglycol explosives on man were noted.

About one to three days after cessation of exposure, sudden death could strike isolated workers in the explosives industry. Gross et al (1942), aware of these sudden deaths during the 1930's, started experimental investigations concerning the effects of nitrate esters on cats and found nitroglycol to be twice as toxic as nitroglycerine.

In 1952 Symanski reported three cases of sudden death in workers exposed to mixtures of nitroglycerine and nitroglycol and he also mentioned another 37 fatal cases from the USA, assuming nitroglycol to be mainly responsible. More recent reports have been summarized by Carmichael & Lieben (1963), and Hilbert (1966).

The sudden deaths among explosives workers sometimes have been preceeded by symptoms simulating angina pectoris, and it is well known that explosives workers used to bring dynamite to their homes during the weekends to avoid abstinence symptoms (Hunter 1975). The symptoms of abstinence seem to be more frequent and more severe for nitroglycol than after exposure to nitroglycerine (Boström et al 1957). Lange et al (1972) studied five munition workers with manifest ischemic heart symptoms and found normal coronary angiographies but a hemodynamic impairment in the exercise test. One patient, studied 74 hours after removal from exposure, demonstrated severe and diffuse spasm of the coronary arteries and he also showed significant digital arterial spasm. Sublingual nitroglycerine administration resulted in a marked improvement in the angiographic findings.

Chronic effects?

Coronary sclerosis has been lacking in the post mortem findings of many cases of sudden death in the explosives industry. At least in Sweden the insurance compensation policy seems to have been that no signs of coronary sclerosis may be present to entitle compensation. Besides the sudden deaths an excess mortality in coronary heart diseases and cerebrovascular diseases have been suspected. Some support for this suspicion is provided by the tendency to increased diastolic blood pressure among persons with long-term exposure to nitroglycol (Broström et al, Lange et al).

Furthermore, the effects of nitrate esters on the vessels might support a general assumption of chronic effects regarding the cardio-cerebrovascular morbidity.

Absorption of nitroglycerine and nitroglycol takes place through inhalation as well as through the skin (Gross et al 1960; Götell 1976). The skin absorption probably used to be very important in earlier days, as protective gloves were not worn. Various relations in the content of nitroglycol and nitroglycerine have been used in dynamite. Earlier the nitroglycerine component predominated but the relations have been reversed since the beginning of the 1960's. However, nitroglycol tends to predominate in the air because of its greater volatility and is also absorbed through the skin to a greater extent than nitroglycerine. Absorption studies concerning the skin route as well as the inhalation have been carried out during the last years and the nitroglycol concentration in blood might sometimes be considerable among the more heavily exposed workers (Sundell et al 1975).

Regarding the substantial exposure and the possible chronic effect as a cause of increased cardio-cerebrovascular mortality, a case-referent study (case-control study; McMahon & Pugh 1970, Miettinen 1976) was undertaken at a Swedish explosives factory.

Parish register used as source

The register of deaths and burials in the parish around the factory was used as the source of subjects for the study dealing with the period 1955–October 1975. In the parish there are also mines, some engineering industries, service industries, forestry and agriculture. The register of deaths and burials seemed to contain complete diagnoses from the death certificates.

The study is confined to men aged 37–70. These age limits were chosen since less specific diagnoses could be suspected to occur in higher ages, and consequently of less interest with regard to excess mortality from industrial exposures. Moreover, the working conditions of the employees were traceable in available factory registers back to 1921, i.e. people dying at ages above 70 could have been employeed prior to 1921 if they were younger than 36 years of age in that year.

"Non-cases"

The diagnoses from the death records were blindly classified as to the underlying cause of death. Some cases, not being classifiable as to the underlying cause of death, were primarily excluded from the study. Because of a high rate of fatal explosion accidents in the explosives industry several exposed individuals become "non-cases" because of that specific occupational risk and appear in the reference group. To avoid this bias all explosion accidents were excluded from the study, some coming from another chemical department (unexposed) in the explosives industry and some from mining. Individuals with the diagnoses diabetes mellitus or primary debilitas were also excluded since individuals suffering from these conditions do not usually get employed in exposed jobs, i.e. particular relations might occur between status of referent and nonexposure.

In this study cases are defined as ischemic heart diseases and cerebrovascular diseases (ICD 410–412, 427–428, 430–438; WHO 1965). As referents were choosen persons who had died from all other diseases and accidents remaining after the primary exclusions. The frequency of exposure among cases and referents could be expected to be similar under the null hypothesis after the exclusions made, since there is hardly any reason to suppose primarily different relations to exposure.

Alcoholics are out

Since 1954, employment tests and annual health check-ups have been carried out with the intention of excluding persons with signs of cardiovascular abnormalities, i.e. ECG-abnormalities or hypertension, from exposed work. The effect of this procedure should be expected to counteract an excess morbidity in cardio-cerebrovascular diseases among the exposed.

The smoking habits are not known either among the exposed or the unexposed but as smoking is prohibited during exposed work the consumption of tobacco is probably lower among the exposed. Anybody known to misuse alcohol has been placed in non-exposed work for safety reasons.

Therefore alcoholism is believed to be more common among the unexposed. Employees of the factory live spread out in the parish, so if there are any differences in the hardness of the drinking water this can hardly influence the results. The persons who have died in the parish have almost exclusively been native Swedes.

Since age might be a confounding factor (Miettinen 1974 b) when the exposure is taken as occupational years in exposed work, stratification was applied as shown in table 1.

Assessment of exposure

The lists used in this context were blinded with regard to case-referent status. Type of occupation and the duration of employment were assessed for cases and referents by a company representative through available registers. The exposure has been classified as full-time or part-time exposure, the latter referring to temporary exposure, e.g. for repairers, transport and magazineworkers etc. Full-time exposed persons are kneadhouse workers, patroneers, pressurers etc, recieving exposure partly by inhalation, partly through the skin. Persons with less than 1 year of exposure have been excluded from the study to avoid dilution of the material by low-exposed people (compare Cutler et al 1954).

The statistical analyses of the data are based on the Mantel-Haenszel procedures for the calculation of p-values and for the estimation of the overall risk ratio (Mantel-Haenszel 1959). The principles applied for the determination of the standardized risk ratios have been outlined by Miettinen (1972) along with the method for calculating the confidence interval of the risk ratio (1974 a). The increase of effect over categories of exposure has been tested according to Mantel (1963), scoring exposure categories as 0, 1, 2.

Results: long exposure–excess mortality

The study included 169 cases and 184 referents. The primary exclusions comprised 41 non-employed, 9 exposed (of which 7 were explosion accidents) and 5 nonexposed employed. 21 cases and 10 referents were found to have been eposed i.e. 12,4 per cent of the cases compared with 5,4 of the referents. The crude risk ratio was consequently 2,5 for cardio-cerebrovascular diseases among the exposed in relation to the non-exposed and the Mantel-Haenszel estimation was 2,6. It seems unlikely that the distribution of exposed persons among cases and referents is due to chance.

Considerable excess . . .

The results of this study suggest a considerable excess mortality in ischemic heart diseases but also in cerebrovascular diseases among men with long-time exposure to explosives based on nitroglycerine and nitroglycol. This effect is predominantly present in ages 55–70 with more than 20 years of exposure. As in most epidemiologic studies the comparability of cases and referents might be discussed. Known risk factors for the studied diseases like the use of alcohol and tobacco might be more frequent among the cases than among the referents, but, as said in the introduction, there is no reason to believe that the exposed employees would use more alcohol or tobacco than the non-exposed, e.g. the use of tobacco and alcohol might be modifiers of effect but hardly confounding factors (Miettinen 1974 b) as not (positively) associated with exposure.

Age seems to bring about rather considerable effect modification as the excess mortality mainly derives from the higher age classes. Among the non-exposed, however, the ratio between cases and referents are rather much the same for the age strata 51–60 and 61–70, e.g. within that 20 year interval there is no particular incremental risk associated with age. Therefore, 10 year intervals for control of the possible confounding effect from age seem to be reasonable. In fact there is a negative confounding by age since the ratio of the crude risk ratio and the SMR, i.e. the confounding risk ratio, is less than one.

Improved health care

Whereas observational bias concerning the exposure can be excluded, the correctness of the diagnoses might be discussed. However, there is no reason to believe that any diagnostic errors, that might exist, would have primary relations to exposure or non-exposure since the determination of underlying diagnoses of death in this investigation was made blindly. According to de Faire et al (1976) the correctness of the death certificates in Sweden can also be relied on. As case-referent studies do not demand knowledge about all cases that have been exposed, migration into or out of the parish will not distort the study, presumed that the migration does not have primary relations to the causes of deaths in terms of cases and referents or to exposure versus non-exposure, and this is hardly the case.

An explanation for the undermortality in the first age stratum and for persons with less than 21 years of employment might be found in the preemployment investigations and repeated health check-ups which have been offered the exposed workers in the company in order to separate persons susceptible to cardio-cerebrovascular diseases from exposure. This might influence the morbidity pattern for the next few years but a long-term effect can hardly be expected. The good consistency with the cardio-cerebro-vascular mortality among the non-exposed employees (excluding white-collar workers and the non-employed inhabitants of the parish) certifies the validity of the study as to the exclusions made and with regard to the comparability of cases and referents at large.

The Monday morning fatality

As similar studies from this type of industry are lacking there is little in support of an overmorbidity or overmortality in cardio-cerebrovascular diseases due to nitroglycerine/nitroglycol exposure and it is difficult to discuss the pathogenetic mechanism. However, there is the possibility that the vasoactive substances in dynamite might have long-term effects. It might be mentioned that in support of our observations there are some unpublished data from the explosives industry in the UK, but further studies on the explosives workers are needed. In Sweden there are no further populations of any reasonable size with a corresponding pattern of exposure and additional studies from other countries are eligible.

The fifteen-fold risk for men 20–55 years of age of dying from coronary disease, reported by Carmichael & Lieben, was thought attributable to "Monday morning fatality" according to the authors. Sudden death in the abstinence phase might be discussed for three cases in this report, but cannot explain the majority of deaths having occurred months or years after last exposure.

It should be remembered that besides nitrate esters there is also exposure to ammonium nitrate, which can amount to about 50 per cent of the content in the explosives. The hygienic conditions at the time of relevant exposure for the employees considered in this study, i.e. during 1930–70, were probably worse than today but more exact figures are lacking. Also the skin resorption makes any attempt to assess more exactly the amount of exposure a difficult matter.

It seems urgent to follow exposed populations in the future as the exposure conditions probably will be much improved through increased automation which will decrease skin contact. Furthermore ventilation improvements, effective personal protective equipment and a good hygiene as well as validated health check-up programs are desirable. ■

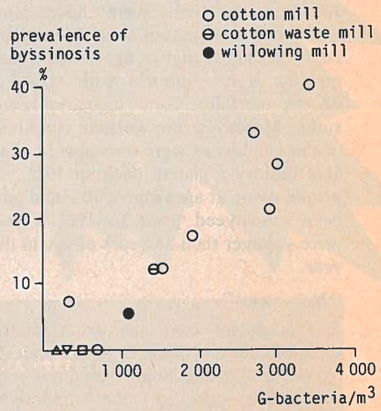
In epidemiological studies performed in several countries a relationship has been found between the dust level in different parts of cotton mills and the prevalence of byssinosis. High dust levels as well as a high incidence rate of byssinosis have been observed in card rooms. Workers in other parts of the cotton mills, such as in the spinning department, who are exposed to dust levels which are sometimes equal to or higher than those in the card rooms, have a considerably lower incidence of byssinosis.

□ In certain studies a relatively low incidence rate of byssionosis was found in spite of high dust levels. – The above observations indicate that specific components of the dust are responsible for the disease producing effect. The dust level may not be the optimal way to express the occupational health hazard encountered in cotton mills.

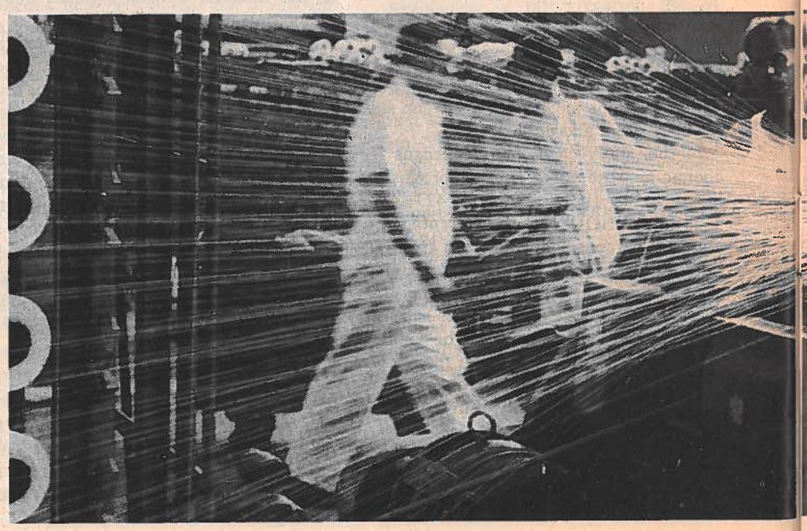
Animal experiments

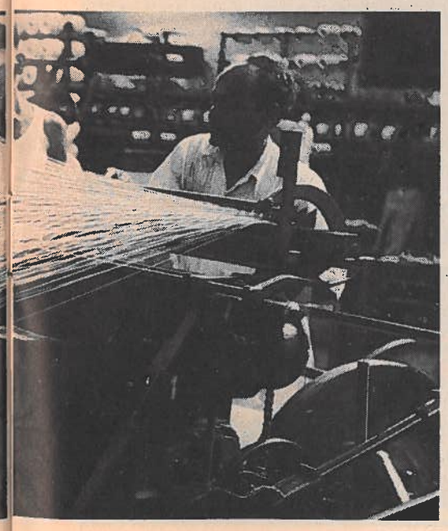
In inhalation experiments on animals acutely exposed to cotton dust or extracts thereof, it has been demonstrated that the number of polymorphonuclear leukocytes (white blood cells) in the lungs increased after the exposure. The increase occured within a few hours and reached its highest level at about 24 hours after exposure. When different dusts were studied, a close relationship was found between the bacterial contamination of the dusts and their ability to cause the leukocyte reaction in the lungs.

Cultures from different cotton products gave values up to several million bacteria per gram of raw material. A large proportion of the bacteria on cotton plants belong to a morphological type which is identified by its staining characteristics, the so-called Gram-negative bacteria. The majority of such bacteria can be classified according to a few easily recognizable strains. When different strains of bacteria found on the cotton plant were assessed for their leukocyte mobilizing capacity, the highest acitivity was found among the species *Enterobacter*, *Klebsiella* and *Pseudomonas*. A biochemical characteristic of such bacteria is their ability to produce endotoxins – a biologically highly active material. Determinations of the amount of endotoxin demonstrated levels up to 2 mg/g of material in dust found in the air of card rooms.



Relation between prevalence of byssinosis and airborne Gram-negative bacteria





Studies in the US and the UK

In order to assess the importance of the Gram-negative bacteria for the development of pulmonary symptoms in humans after exposure to cotton dust, two epidemiological studies have been performed. The first study took place in seven cotton mills in the Manchester area. In each mill, determinations were made of the dust level in milligrams/m³ and the number of airborne Gram-negative bacteria. The prevalence of byssinosis in the different mills was evaluated using a standard questionnaire based upon the original Medical Research Council questionnaire.

The observed relation between the prevalence of byssinosis and dust levels shows that no apparent dose response relationship was present. The relationship between byssinosis and the amount of Gram-negative bacteria in the air is illustrated in the figure, which demonstrates an improved dose response relationship.

The second study was performed in 19 different cotton mills in the United States. Changes in respiratory function over the working day were measured in a routine medical survey program and determinations were made of the amount of airborne dust.

In addition, the bacterial contamination of the bale cotton used in the different mills was determined.

Also in this study, a poor dose response relationship was found between dust level and the respiratory function tests throughout the day, whereas the number of Gram-negative bacteria in the bale cotton was significantly better related to the pulmonary symptoms.

Control bacteria!

Results from inhalation experiments on animals and from epidemiological studies in cotton mills demonstrate a close relationship between the amount of Gram-negative micro-organisms in the cotton mill environment and the development of pulmonary symptoms in the exposed worker.

An improvement in the working environment will be obtained by lowering the dust levels, which has also been demonstrated in several previous studies. However, the results from the studies discussed here suggest that a standard for dust levels is not likely to provide sufficient protection for the exposed workers. Byssinosis may be present in mills even if the dust level is very low.

The number of Gram-negative bacteria or the amount of endotoxin present in the bale cotton or in the cotton mill air should be used to supplement or replace dust concentration standards. ■

Dust level standard not enough protection against byssinosis

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Paint manufacturing a high risk operation

□ "We have found very high levels of exposure to solvents in our survey of the Swedish paint manufacturing industry," says professor Ulf Ulfvarson of the Occupational Safety and Health Administration, who has led the investigation of the hazards in this branch, traditionally recognized as one of the most hazardous of the entire chemical industry. There are two thousand employees in the paint manufacturing industry. Two hundred of these are in very dangerous operations. Details of the exposure to solvents are found in the table.

Dust also causes great problems in this branch of industry. The dangerous agents in the dust are lead, chromium and fine quartz. But you get effects similar to silicosis also from silicon dioxide, which is used a great deal. In addition to negative effects on the lungs, you also find a number of skin irritations caused by physical contact with these dangerous substances.

"We have established an organisation for systematic surveys of hazardous professions and branches," says Ulfvarson. "This organisation covers both measuring and medical studies. At times the two methods are used simultaneously. Our next medical study will start this fall. We have a grant from the Work Environment Fund to follow up the survey with medical studies of the skin diseases."

Many skin problems

Of the workers interviewed, 40 percent suffered from skin irritations or had such problems. Nearly 50 percent of these cases were definitely job related. At least a fifth—probably a third—of all employees in the paint manufacturing industry seem to suffer from job-related skin problems.

Follow up

The first job ahead is now to follow up this survey ordered by union and management in the paint manufacturing industry with medical studies of the heavily exposed workers to see which acute and chronic effects the exposure has produced.

It would of course be very desirable also to study the effects of long-term exposure to solvents. Such a study would have to be undertaken immediately after a vacation, when the acute symptoms would have receded. But for such a study it would be necessary to take workers out of production for a period of time and you would also need a control group which would not have been exposed to any solvents.

"But right now," says Ulfvarson, "we must use our limited resources to try to solve more immediate problems."

Worker's and employer's request

The Chemical Workers Union and the employers' federation covering the industry have long agreed that paint manufacturing is a very hazardous operation and they jointly asked Ulfvarson's unit to undertake the study after getting research money from the Work Environment Fund.

The Occupational Safety and Health Administration has worked for many years surveying dusty work environments like foundries. An additional problem area receiving such attention is welding. But apart from these studies there is no long-term strategy for surveying dangerous environments, Ulfvarson admits, but his unit must be on the spot when the inspectorate finds high exposure levels. These smaller jobs may then develop into full branch studies.

Standardize methods

Another important task of Ulfvarson's department is to assist the standards and inspection department by developing standardized methods of measuring and by developing equipment to eliminate dust and fumes.

"To guarantee the rule of law under the new and stricter Work Environment Act and application of the new standards with very low TLVs, we must also be able to recommend methods to reach the new targets," says Ulfvarson.

Professor Ulfvarson is convinced that the paint manufacturing industry will be able to solve the problems documented by the survey. Union and management have already set up a joint working party charged with the task of finding and developing technical solutions. The very fact that the parties jointly asked for the survey demonstrates that they are prepared to take the consequences.

BV

High levels of exposure

Summary of solvent concentrations in the breathing zone of workers in the paint industry during different critical operations. The sum of the standardized concentrations of all present solvents was calculated for each sample. The range of these sums in each operation is presented with a specification of those solvents contributing to the sums with at least one fifth.

As can be seen in the table, high concentrations of solvents are found in all investigated operations. The mean of the observations approaches or exceeds the occupational health standard for short periods (1.25 to 1.5) in all operations except in the tinting department and in the laboratories. Also in these two types of departments there are many single observations above the standard. Only in a few cases are respirators used. The worst situations are found in connection with manual cleaning of equipment with solvents. Only in 7 cases out of 51 was the sum of standardized concentrations below 1.5.

Operation	Number of observations	Range of sampling times, min.	Mean and range of sums of standardized concentrations	Principle solvents (number of cases in which the solvent was found)
Charging solvents	33	4–43	mean = 2.0 0.2–16	xylene (16), mesitylene (4), toluene (4), styrene (2), butanol (9), esters and others
Pigment dispension, (grinding, rollmilling etc) + emptying of vessels	18	9–66	mean = 1.5 0.2–4.4	xylene (13), butanol (4) and others
Tinting, thinnig	14	15–32	mean = 0.9 0.1–2.0	xylene (11), butanol (3) and others
Can filling, paints	39	11–32	mean = 1.3 0.02–6.6	xylene (23), alkanes (4), butanol (7), bensen (4), toluene (6) and others
Can filling, thinners	14	9–20	mean = 1.8 0.1–7.4	toluene (3), xylene (5), trichlorethylene (3), esters (2), aceton (1) and others
Manual cleaning of equipment with solvents	51	3–28	mean = 5.7 0.5–30	xylene (33), butanol (8), toluene (13), metylenechloride (9), esters (7), ketones (4)
Laboratory work, cleaning with solvents, spraying paints, grinding, oven drying	22	7–25	mean = 0.9 0.06–3.0	xylene (11), toluene (7), ethylacetate (4), and others

The safety and health administration

☐ By international comparison the Swedish occupational safety and health administration is remarkable in several respects.

It includes an occupational health department which in other countries would be independent, possibly even under another department of the government.

It is headed by a board of laymen, union and employer representatives and a couple of members of parliament, but the director is chairman of the board.

Even the regional administration of the inspectorate has boards, where union and employer representatives participate in the decisions.

The inspectorate visit some 75,000 workplaces in a year out of a total of 160,000. Still the inspectorate cannot fill any police function. Rather, the safety and health organization at the workplace is the backbone of the work environment supervision. An important job is being done in the field of supervising working hours. Overtime is strictly regulated in Sweden.

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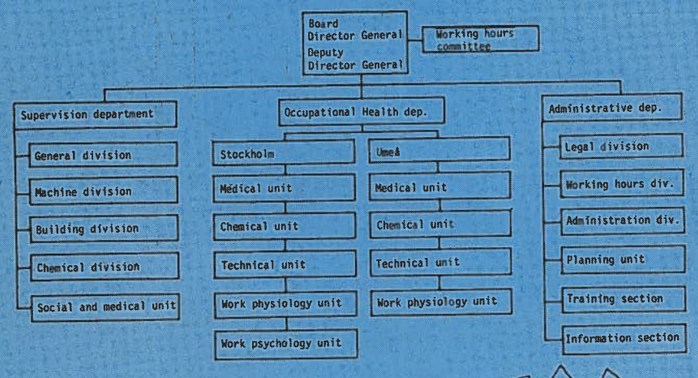
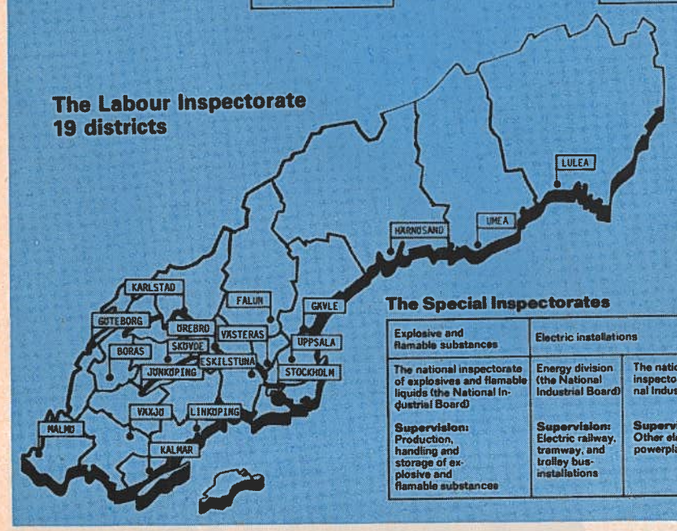
Wennerbergsgatan 10
100 26 Stockholm 34

The Ministry of Labour
The National Board of Occupational Safety and Health



The Labour Inspectorate
19 districts



The Special Inspectorates

Explosive and flamable substances	Electric installations	
The national inspectorate of explosives and flamable liquids (the National Industrial Board)	Energy division (the National Industrial Board)	The national electrical inspectorate (the National Industrial Board)
Supervision: Production, handling and storage of explosive and flamable substances	**Supervision:** Electric railway, tramway, and trolley bus-installations	**Supervision:** Other electrical powerplants

The Work Environment Fund

☐ All employers, private and public, pay 0,1 percent of all wages to a Work Environ-ment Fund, ASF.

The Fund was set up in 1972 in conjunction with the new workmen's compensation act. The income in 1977 will be 120 million kronor.

The Fund supports research, development, education and information in the work-environment field. Both chemical and physical enviromental problems are studied as well as psycho-social problems.

The Fund mainly supports research with an immediate practical application. The education and information activities serve to bring the results of the research to workers and industry. The activities of the Fund are decided over by an executive board. Eight of the board members are nominated by the unions and the employers' organizations. The government nominates three.

The secretariat of the Fund reviews grant applications, initiates other projects and keeps in touch with the scientists. Unions and employers are involved in steering committees.

Arbetarskyddsfonden
Wenner-Gren Center
Sveavägen 166, 11 tr
113 46 Stockholm

The Society

☐ The Society for Occupational Safety and Health (Föreningen för Arbetarskydd) is a voluntary organization. The members are a number of organizations, including the unions and the employers' federations. Individuals can also be members.

The Society sells most of the safety signs and posters used in industry. But its biggest task is that of publishing the leading safety and health journal in Sweden, ARBETSMILJÖ, which has a circulation of 140,000. It appears 15 times a year. The ASF subscribes to Arbetsmiljö for all safety stewards.

Quality of Work

☐ The latest addition to the list of work-environment institutions is the Swedish Quality of Work Center established as part of the new collective bargaining act at the beginning of this year.

This center also has a joint board of employer and union representatives. The main function of the center is to bring the ideas of the new act into practical application at the shopfloor.

The center will do its own research – it has three professors in work organization – and will encourage research by other institutions on the application of the co-determination at work act. The center will get its research finances through the ASF.

Centrum för Arbetslivsfrågor
Fiskartorpsvägen 15 D,
114 33 Stockholm

The Joint Council

☐ In an effort to avoid legislation in the field of industrial relations the employers' federation and the trade union federation, SAF and LO, concluded the Basic Agreement in 1938. A series of agreements under this Basic Agreement followed regulating activities in the field of vocational training, women's questions, work study, and safety and health. Joint offices were set up to promote cooperation. Now only safety and health has its own joint office, Arbetarskyddsnämnden – the joint safety and health council. But this office has grown into a substantial center for work- environment education and information.

Its basic course – **Bättre arbetsmiljö** – to be studied in study circles, has been printed in 260,000 copies. Follow up courses cover such areas as chemical hazards, noise, planning of production facilities, ergonomics, lighting and organization of the local safety and health administration.

ASF has helped finance the Study kits, but all safety and health education – except the more political courses run by unions and employers' federations for their members – is done during paid working hours and charged to production. By now almost all 106,000 elected safety stewards have studied the basic course, which is intended to bring the new safety and health legislation into practical life. The continuing educational activities for the safety stewards are now directed towards technical training and specialization.

Arbetarskyddsnämnden
Sveavägen 21, 5 tr
Box 3208
103 64 Stockholm

Joint administration new trend in safety

☐ The building industry is in many ways unique and therefore needs a special kind of safety and health service. In Sweden the industry's safety and health activities are run by a joint foundation, BYGGHÄLSAN. It has a central service function in Stockholm, a district administration and, when necessary, mobile clinics serving the building sites. Bygghälsan covers both the safety and the medical aspects and also has the capacity for research activities, like an epidemiological study of the painting and plumbing professions.

The success of Bygghälsan is now leading to new similar services for the transport industry, the auto repair industry and restaurants – all industries with very specific ergonomic and health problems.

This development runs parallel to the development of occupational health and safety centers for small enterprises, which are not big enough to have their own full time safety and health staff. So far less than 50 percent of all employees in the country are covered by industrial health services, but with the simultaneous development of branch services like Bygghälsan and cooperative health centers it is estimated that all workers will be covered before too long.

Another recent development is that of regional safety stewards – full time safety stewards appointed in cooperation with management by the unions covering a number of workplaces, which are too small to have their own full time safety stewards.

Bygghälsan
Engelbrektsgatan 31,
100 41 Stockholm

Education the Key to safety and health

☐ The authorities, institutions, organizations, boards and councils looking after the working environment in Sweden are numerous. Some of them are active internationally and we give their addresses for the benefit of the foreign visitors.

However, the most important work in the field of the work-environment is done at the workplace. Authorities and institutions can only serve the safety and health departments on the job, and the most interesting aspect of Swedish safety and health policies is the development of industrial democracy – some would say co-determination – at the workplace in matters of safety and health.

These coordinated efforts are not just happening. They are the result of years of collective bargaining and cooperation at the federation level and at the branch level. The new act, in a way, is only a codification of a situation that has existed for a long time in the good workplaces. The new opportunities for workers and their safety stewards opened up by the new act in the field of planning and control will lead to results as progress is made in the field of education and as the economic situation improves.

Efforts are made jointly, by union and employers' federation to map the work-environment hazards in most branches. These branch safety and health councils request on occasion that surveys be made of specific hazards or of the total situation. The ASF would then come in and finance the survey undertaken by the competent branch of the Occupational Safety and Health Administration or by some other research institution. A steering committee of representatives of management and unions would follow the research and advise the researchers. A case in point is the survey of the paint manufacturing industry.

After completion of the study, the parties – eg the Chemical Workers' Union and the employers' federation for the chemical industry – would sit down and find technical solutions. In the engineering industry there is even a bank of technical solutions that the members of the engineering industry federation can draw on. The results are published in separate information bulletins. Very special efforts are being made in the field of noise abatement. Each industry has a joint ''noise group'' financed by the ASF, and their results are also published.

The Work-Enviroment Fund works further through committees. Two such joint committees cover surface treatment and welding. Extra finances may be needed to develop a new safe method at the workplace. The national board of technical development (STU), under the Department of Industry, has funds for such investments, decided over by a separate board. At present the president of the ASF also chairs these meetings.

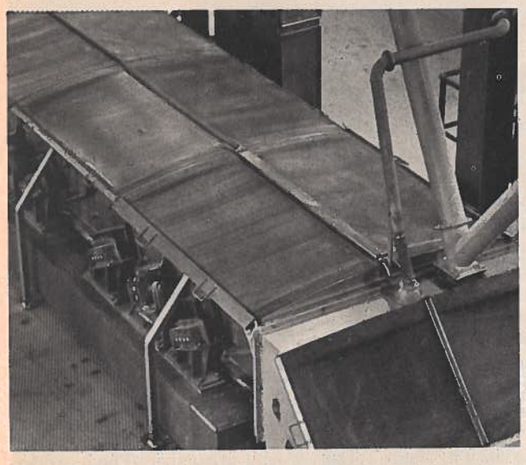
B.V.

The human lung is not a vacuum cleaner.

Dust filled working areas take their toll in sickness. Until now, several different methods have been attempted to solve the problem. For example, a variety of face masks. But these are seldom used — too uncomfortable to work in.
Or large hoods installed over the source of the dust. But, to function properly, these hoods must form a part of a system equipped with powerful fans and dust separators.

THAT'S WHY WE DEVELOPED OUR TRELLEX DUST-SEALING SYSTEM

At Trelleborg we started out on the premise that there must be a simpler solution requiring less energy.
Why let the dust-generating process remain open at all? Rather, isolate the dust by enclosing the entire process.
Trials previously carried out had involved the use of sheet metal or plastic, neither of them ideal for this purpose.
But we had rubber. Easy to shape. Light in weight. And easily the most suitable material for dust-tight enclosures.



A STONE CRUSHING PLANT WITH LESS DUST THAN YOUR LIVING ROOM

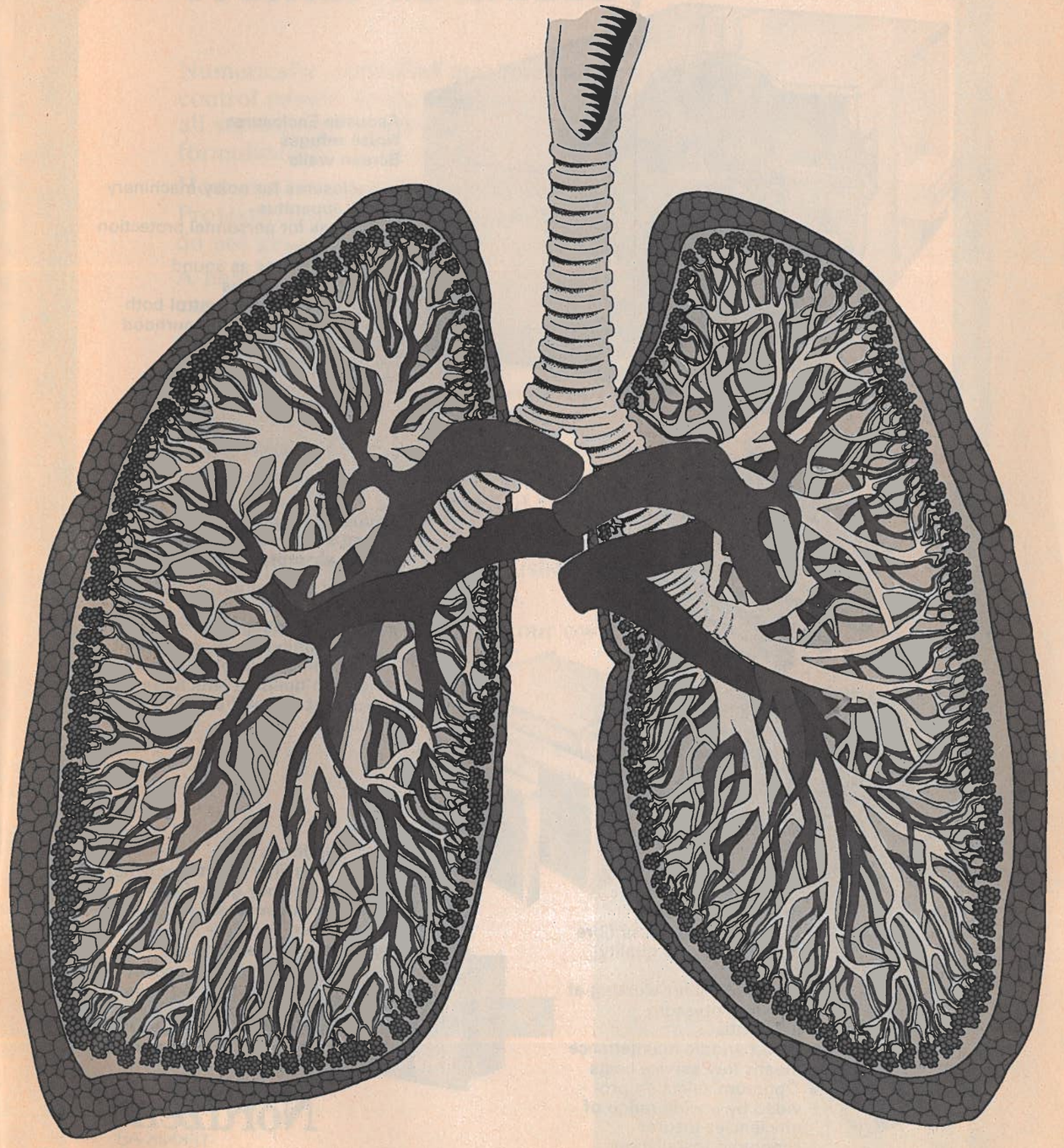
An opportunity to test our theories came when a large stone crushing industry decided to build a new crushing plant some years ago.
We then came into contact with others who were thinking along the same lines — and who were also willing to take a chance on the then untested method of entirely enclosing a dust-generating process chain with rubber sheeting.

One important reason for this decision was, of course, that our system had proven itself more economical. It also required extraction fittings, but their only purpose was to create a partial vacuum, enveloping and retaining the dust when the inspection doors were opened. As a result, fan could be kept to a minimum.
In 1969 the plant started operations. The measured dust was lower than you would normally find in your own living room.
Our new dust-sealing system had lived up to its promise.
And still continues to do so in an ever increasing number of industries.
Get in touch with us. Our experienced engineers can undertake a survey of your plant, large or small, and provide all the facts and figures.

TRELLEBORG

Trelleborg AB, Fack, S-231 01 Trelleborg, Sweden.
Telephone 0410-51 000.

Branch offices in Basel, Bruxelles, Helsingør, Hamburg, Hoogezand, London, Madrid, Oslo, Paris, Sao Paulo, Sydney, Solon OHIO, Turin, Teheran and Vienna.



Stig Sjödin

Worker in industry

Numerically controlled machines and processes
control panels, tools, fixtures, measuring techniques,
all serving the precision
formulated by computers.

How can people fight against it?
Protests charged with pregnant feeling
do not get us very far.

A human being of flesh and blood,
camouflaged as a factory soldier,
asbestos-wrapped, though no war rages –
heart, nerves, and belly cannot submit.
They rebel with all the wails and signals
mustered by mind, soul and body.

Compensation rates are fixed
for worn-out backs and torn-off limbs.
But who will pay for shrivelled souls?

Can we accept "perfect" production
if it cripples the strong and crushes the weak?
Smash the machines?

No! Re-design them to match our own
potentials and frailties.

Numeriskt styrda maskiner och processer,
manöverpaneler, verktyg, fixturer, mätningsteknik,
allt är underordnat en precisionstanke,
som datorerna hjälper till att uttrycka.

Vad har människan att sätta emot?
Ett språk laddat med känslor
förslår inte långt.

Människan står där som hon är,
ibland maskerad till arbetssoldat,
klädd i eldfasta höljen fast det inte gäller krig.
Hennes mage, hjärta, nerver
låter sig dock inte styras,
utan protesterar med hela den somatiska
och psykiska utrustningens signalsystem.

En utsliten rygg, en stympad lem
åtar vi oss att värdera.
Vad kostar en tom själ?

Perfektionen kan också spegla sig i
de många olycksfallen.
Maskinkrossning?
Nej, men styrning med människans förmåga
och brister som utgångspunkt.

Stig Sjödin