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TUM DUNFER

Tom Dwyer

UNICAMP

M. le Professeur Alain Wisner,
CNAM
41 rue Gay Lussac,
75005 Paris

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Cher ami,

je vous écris de l'intérieur de l'état de Bahia – pour être précis de « Chapada de Diamantina » – pour vous faire savoir que je viendrai en France pendant les mois de janvier et février. On m'a invité à l'Université de Nantes où je donnerai un cours sur mon bouquin. Je voudrais profiter de mes passages à Paris (je compte être à Paris très souvent) pour qu'on discute un peu plus sur l'idée de faire quelquechose ensemble à São Paulo-Campinas sur le processus de construction de théorie dans des sciences (ergonomie et sociologie) du travail. J'ai déjà discuté cette idée avec Laerte et Fleury qui l'ont bien aimée.

Par ailleurs, je voudrais vivement vous remercier de nouveau, pour votre compte rendu dans le Travail Humain.

En attendant vous revoir bientôt à Paris je vous souhaite une très bonne année de 1994,

bien amicalement,

Tom Durrafourg

UNIVERSIDADE ESTADUAL DE CAMPINAS
CAIXA POSTAL 1170
13081- CAMPINAS - SP BRASIL

TELEFONE PABX (0192) 39-7766
TELEX (019) 1150

M. le Professeur Alain Vinier,
CNAM
41 rue Gay Lussac,
75005 Paris
FRANÇA (France)

PAR AVION

Remetente Tom Dwyer

Endereço r. Haddock Lobo 547 apto 71

01414-[ ][ ][ ] São Paulo SP.

TOM DWYER

Projeto p/ Cornell.
Tom Dwyer.
NÃO CITA

1.0 Introducao

1.1 O acidente do trabalho fere mais de um milhão e mata mais de quatro mil brasileiros por ano. Resulta em prejuizos economicos calculados como sendo da mesma ordem que o pagamento dos juros sobre a divida externa - 4% do Produto Nacional Bruto (1). Em tempos recentes, o fenomeno se extrapola para fora do local de trabalho para atingir tambem populacoes civis, como nos acidentes de Goiania, Vila Soco ou fora do Brasil, Chernobyl e Bhopal.

1.2 As disciplinas que estudam e agem sobre o acidente (das quais as principais sao ergonomia, engenharia, psicologia e medicina) estao, desde meados da decada de 70, em estado de crise. As bases dessa crise encontram-se

(a) na incapacidade de reduzir de modo significativo os indices de acidentes;

(b) em dilemas de ordem etica;

(c) no surgimento e penetração no trabalho de novas tecnologias (sobretudo as pos-industriais), o que rompe as fronteiras tradicionais entre as varias abordagens;

(d) no custo cada vez maior dos acidentes.

1.3 As disciplinas estão buscando saidas para a crise por tres caminhos bem definidos:

(a) o fortalecimento de cada perspectiva disciplinar e da atuação das disciplinas, por meio da aplicação de soluções padronizadas;

(b) o desenvolvimento de tecnicas de analise de custos e beneficios que servirão como indicadores de onde e como investir em segurança;

(c) o aperfeiçoamento da escola conhecida como segurança de sistemas, que procura planejar niveis maximos de segurança.

1.4 A partir de meados da decada de 70, a sociologia entrou no campo de analise da producao e prevençao de acidentes. Membros de diversas disciplinas agora olham na direção da sociologia do trabalho buscando identificar uma saida para a crise por meio de uma nova analise de prevençao dos acidentes (2).

1.5 A sociologia do trabalho, por sua vez, tambem esta em crise e olha na direção de outras disciplinas (inclusive aquelas que estudam os acidentes) em busca de uma saida (3).

1.6 Existem nesse momento ao nivel mundial alguns centros de excelência que, atraves de seus estudos sobre o acidente associado com o trabalho do tipo pos-industrial, estao produzindo conhecimentos importantes: novas teorizaçoes de causa, novos enfoques da prevenção e dialogos multidisciplinares.

1.7 Com o objetivo de contribuir na producao desses conhecimentos e para o desenvolvimento das minhas ideias, pretendo aceitar um convite para ser um "VISITING FELLOW", convite feito por um desses centros de excelência: o programa Science, Technology & Society, da Universidade de Cornell.

2.0 Objetivos e metas

2.1 Objetivos a curto prazo:

Através de uma análise sociológica das pesquisas de diversas disciplinas sobre a produção de acidentes em industrias "pós-industriais", pretendo:

(a) fornecer uma base sociológica que possibilite às disciplinas considerar um quarto caminho na busca de uma saída para a crise;

(b) ampliar a incorporação dos conhecimentos cientificamente validados dessas disciplinas à teorização sociológica da produção dos acidentes do trabalho.

2.2 Metas a médio prazo:

(a) Contribuir, por meio de trabalhos publicados, para a reformulação dos campos de pensamento sobre o problema de modo a permitir a redução do sofrimento e dos custos dos acidentes do trabalho industrial e pós-industrial;

(b) integrar os conhecimentos de disciplinas não-sociológicas numa reformulação da sociologia do trabalho: num primeiro momento, por meio da oferta de um curso de pós-graduação, num segundo através de publicações nesta perspectiva;

(c) contribuir para que outras disciplinas sejam estimuladas a tomar a sociologia do trabalho como campo de referencia obrigatório em suas reflexões.

2.3 Meta a longo prazo:

Contribuir para a formação de um novo paradigma, do

tipo tratado por Edgar Morin (4), no qual haja um diálogo entre disciplinas das ciências naturais e das ciências sociais.

3.0 Justificativa

Essa justificativa constitui-se de quatro partes:

(a) uma exposição esquemática da diacronia dos acidentes do trabalho;

(b) uma exposição de uma teoria sociológica da produção dos acidentes do trabalho;

(c) a aplicação de uma teorização sobre a intervenção disciplinar em dois tipos distintos de trabalho: industrial e pós-industrial;

(d) a dedução da capacidade de avançar conhecimentos através de uma estratégia que cruza uma perspectiva sociológica da produção dos acidentes com as teorizações disciplinares sobre os trabalhos de tipo pós-industrial.

3.1 Evolução do tratamento do acidente do trabalho - diacronia

Na Europa pré-industrial, os acidentes eram produzidos e suas consequências enfrentadas essencialmente na esfera privada. Como outras formas de infortúnio, eram vistos como punição do pecado - isso era a "causa". As consequências, ao nível do amparo às vítimas e suas famílias, eram assumidas pelas corporações medievais e redes de apoio familiar (5). Não sabemos praticamente nada sobre os índices de produção de acidentes do trabalho em diferentes ocupações. Sabemos um mínimo sobre os sistemas e níveis de indenização e apoio.

O advento do sistema industrial viu a ruptura do velho sistema de gerenciamento das consequências dos acidentes. Ao mesmo tempo, a produção de acidentes transformou-se na medida que o trabalho deixou de ser uma ocupação artesanal ou braçal predominantemente isolada passando a formas industriais e de grande escala (6). Certos fatores combinaram-se para transformar tanto a produção como o gerenciamento das consequências dos acidentes numa questão de ordem pública. Resumidamente, com base sobretudo de pesquisas inglesas, estas podem ser enumeradas da seguinte forma: mudanças no valor cultural atribuido à vida, reformas políticas, movimentos sociais e indignação pública diante do sistema industrial e os danos provocados por ele. O problema político é resolvido administrativamente. Isso leva ao desenvolvimento de uma série de instituições para lidar com o problema. Os Estados estabeleceram legislações de fábrica, empregaram inspetores, desenvolveram e implantaram legislações de indenização e instituiram taxas de indenização estabelecidas de forma legal. Os patrões forneceram um mercado para técnicos, médicos, enfermeiras, psicólogos, etc., que passaram a intervir no mercado de trabalho. Disciplinas acadêmicas especializadas foram criadas e desenvolvidas para lidar com o problema.

A medida que as sociedades mais avançadas agora vão deixando para trás a era industrial para entrar na era pós-industrial, uma importante mudança pode ser observada na área da produção das vítimas de acidentes, com o avanço das industrias "de conhecimento intensivo" ("knowledge intensive", ex: energia nuclear, substâncias químicas nocivas, engenharia genética): os acidentes agora ameaçam afetar populações civis em massa, gerações

futuras e o sistema ecológico.

Isso está em ruptura marcante com o sistema industrial, onde os acidentes raramente afetavam outros além dos trabalhadores e as consequências, apenas eles proprios e seus dependentes. Portanto, a questão da indenização ultrapassa os limites aos quais a civilização industrial a confinou. Há sinais de que as atitudes culturais estejam mudando. A morte resultante desse tipo de acidente é vista como menos aceitável do que a morte provocada por outros tipos de acidentes, um fenômeno conhecido como "efeito do pavor" ("dread risk") (7). Os movimentos sociais mobilizam-se para contestar as novas industrias. E, fato novo, a adequabilidade das instituições herdadas da sociedade industrial para lidar com a questão, não só nas situações do trabalho pós-industrial, mas também do trabalho industrial, passa a ser questionada (8).

3.1.a O Impasse: reflexões teóricas e metodológicas

O impasse a que chegaram as disciplinas tradicionais que tratam da produção de acidentes, e o questionamento dessas disciplinas provocado por isso, levou a novos movimentos teóricos e metodológicos.

No plano teórico, três caminhos definidos e um caminho emergente podem ser traçados. A abordagem baseada em padrões de segurança ("standards approach"), pela qual regras e regulamentos semelhantes são aplicados a todos os locais de trabalho numa firma, setor, industria ou país para garantir o atendimento das necessidades de segurança percebidas, está sendo revista e aperfeiçoada. Pede-se o fortalecimento dos mecanismos de fiscalização (9). A segurança de sistemas, pela qual

se busca o planejamento total da atividade de modo a garantir um maximo de segurança, está tendo crescimentos espetaculares nos setores da energia nuclear, substancias quimicas nocivas e aviação. Estão sendo tomadas medidas para transpor essa via para a industria competitiva (10). A analise de custo-beneficio, sobretudo em paises com governos liberais do ponto de vista economico, procura reexaminar todas as medidas de segurança para conservar e promover só aquelas que se revelem lucrativas (11). Pode-se identificar também um quarto caminho de renovação, em fase incipiente: as tentativas feitas pela engenharia, medicina, ergonomia, direito e, de um ponto de vista mais académico, da história, para introduzir dimensões "sociológicas" à análise da produção, prevenção e indenização dos acidentes do trabalho (12).

Houve também uma ruptura metodológica. Em 1967, Faverge observou a raridade dos estudos que incluissem referências ao que os trabalhadores fazem no local de trabalho e aos significados atribuidos por eles a essas ações (13). Vinte anos depois, tais estudos tornaram-se mais comuns e, quer se refiram ao trabalho industrial ou pós-industrial, fornecem novos conhecimentos a respeito da produção e prevenção de acidentes. Alguns desses estudos têm como ponto de partida a idéia de que para entender o papel da medicina, ergonomia, engenharia, etc., sua articulação no local de trabalho deve ser examinada. Outros procuram examinar o local de trabalho como uma unidade sincrônica, sem referência à influência das mudanças socio-historicas (do tipo examinado por historiadores, economistas e teoricos do processo de trabalho) ai ocorridas. Vou apresentar a visão produzida por alguns estudos de caso realizados por membros desta ultima corrente. Essa visão é vista como fornecendo uma

base para a reconstrução, por meio de um processo que usa a lógica indutiva, das interpretações teoricas da produção de acidentes. Será traçada uma teoria sociológica da produção de acidentes que recupere os conceitos clássicos e as discussões da sociologia do trabalho. Numa seção posterior, a analise diacronica será reintroduzida e tanto o trabalho industrial como o pós-industrial serão analisados.

3.2 Em Direção a uma teoria sociológica da produção dos acidentes

3.2.a Estudos de caso:

Fitzpatrick (14) constata que os mineiros de carvão norte-americanos não permitem que seus companheiros de trabalho realizem tarefas perigosas. No entanto, nem todos os estudiosos dessa questão consideram que os trabalhadores estão dispostos a proteger a si proprios: Haraszti (15) discutiu como os trabalhadores violam os regulamentos de segurança para ganhar incentivos financeiros. Outros pesquisadores podem constatar que os trabalhadores referem-se a valores masculinos para justificar a violação dos regulamentos. No caso particular dos índios norte-americanos trabalhadores do setor da construção civil, é mencionado que os patrões podem tomar a iniciativa de brecar os trabalhadores ansiosos demais por serem valolizados por sua coragem em situações tidas como particularmente perigosas (16). Em alguns casos, são os patrões que pressionam seus empregados para que estes trabalhem em situações arriscadas (17). Mas também pode acontecer de os trabalhadores não terem um conhecimento adequado dos

perigos que enfrentam. Mineiros norte-americanos opuseram-se ao uso de explosivos permissíveis, o que foi considerado por Graebner como sinal de "uma terrível ignorância" (18).

3.2.b A construção de insights teóricos: um esboço de teoria das relações sociais do trabalho

Estes poucos exemplos são ricos em insights sociológicos. Em primeiro lugar, tanto trabalhadores como administradores (enquanto agentes dos patrões) estão envolvidos numa relação que estabelece o grau pelo qual os trabalhadores se expõem ao perigo e o grau ao qual os companheiros de trabalho e a gerência irão tentar modificar isso. A recompensa pelo esforço, seja ela monetária e oferecida pelos patrões ou simbólica e construída em termos dos sistemas de valores dos trabalhadores, pode ser aceita ou recusada pelos trabalhadores. A recompensa pelo trabalho também é conquistada através do número de horas trabalhadas. Quando estas excedem a capacidade dos trabalhadores, como foi mostrado nos primeiros estudos psicológicos, podem ocorrer acidentes (19).

Em segundo lugar, as decisões de trabalhar ou não com determinados riscos podem ser tomadas sob coerção, quer por parte dos patrões ou dos colegas de trabalho. A recusa de trabalhar com um determinado nível de risco pode também ser combatida por meio da coerção -quando há o apoio de regulamentos, e o que se chama de "autoridade".

Em terceiro lugar, o conhecimento que os trabalhadores têm da tarefa e de elementos desta, parece ser um fator essencial para permitir decisões informadas

quanto a trabalhar ou não em determinadas situações de risco. Os trabalhadores frequentemente buscam aumentar seus conhecimentos sobre o trabalho de forma a evitar ficar sujeitos à má qualificação ou a desorganização do local de trabalho.

O primeiro conjunto de observações diz respeito ao uso dos sistemas de recompensa para gerenciar o trabalho. Muito discutido tanto na literatura sociológica como administrativa, este é o nível de recompensa (20). O segundo conjunto está ligado ao uso do poder como recurso gerencial e à capacidade dos trabalhadores de combater isso e desenvolver um contra-poder próprio. As discussões sobre esse nível, chamado nível de comando, embora realizadas por pesquisadores tais como Gouldner e Fox (21), são menos comuns nos textos. O terceiro grupo, representado em textos tais como os de Taylor e Braverman (22), recebe tratamento em profundidade tanto pela bibliografia sociológica como administrativa. Este grupo se refere à tentativa de dominar o trabalho através da tomada de controle do conhecimento do trabalho e sua distribuição via divisão do trabalho, concepção de tarefas ("job design"), coordenação do trabalho e qualificação do trabalhador. Este é o nível organizacional.

A forma pela qual a relação do trabalhador com seu trabalho é gerenciada é uma relação social, e tem-se considerado que o trabalho é gerenciado em três níveis de relações sociais. O ferimento ou morte do trabalhador são vistos como um produto do funcionamento das relações sociais em cada um desses níveis (23). Essa conceitualização, que tem sido objeto de aceitação cada vez maior (24), tem como marco teórico a obra de Alain Touraine.

3.3 Aplicando a teoria de forma diacronica: a analise da producao de acidentes no trabalho industrial e pos-industrial

Atraves da investigacao das origens das praticas modernas de prevencao de acidentes, este autor descobriu cinco efeitos distintos do investimento em medidas de prevencao baseadas na engenharia. Sao eles: efeito de investimento eficaz, efeito de nao-investimento, efeito de desigualdade de investimento, efeito de acidente novo e efeito do abalo das nocoes de verdade e justica por parte do trabalhador. Esses cinco efeitos sao produzidos de formas analisaveis em termos economicos, politicos ou sociais. Esses mesmos cinco efeitos voltaram a ser detectados em pesquisas posteriores realizadas por este autor sobre o trabalho pos-industrial.

E importante delinear esses efeitos na medida que sua existencia revela uma continuidade entre pasado e futuro. Tipicamente, quando sao realizados investimentos em seguranca, so o efeito do investimento eficaz e considerado. Os outros efeitos observados seriam chamados por Boudon de "efeitos perversos" (25). Minha hipotese e que tanto o reconhecimento generalizado da natureza desses efeitos como a pesquisa em profundidade sobre sua producao por todas as areas da atividade de seguranca industrial devera provavelmente ser de ajuda consideravel na reformulacao das praticas de prevencao de acidentes do trabalho.

Procedamos a um breve exame desses efeitos:

O efeito do investimento eficaz e produzido quando um investimento resulta na reducao dos indices de acidentes tecnicamente definidos que o investimento tinha o

objetivo de combater.

A analise de Hair dos acidentes nas minas britanicas ao longo do seculo 19 mostra que investimentos em medidas tais como a lanterna Davy e melhoras no sistema de ventilacao foram associados a uma queda na taxa de mortalidade causada por explosoes: de 5 a 6 por mil trabalhadores por ano no Nordeste da Inglaterra no inicio do seculo 19, esse indice caiu para 0,9 por mil em 1851-3 (26).

Na analise de Charles Perrow, autor de "Normal Accidents", acidentes por falha de componentes sao definidos como falhas isoladas ou multiplas passiveis de antecipacao e entendimento. Os investimentos em planejamento de sistemas e treinamento apropriados sao vistos como meios efetivos para eliminar esse tipo de acidente (27).

O efeito do nao-investimento ocorre quando um acidente tecnicamente definido e produzido, mas nao sao feitos investimentos para reduzi-lo.

Hair observa que os acidentes de todos os tipos nas minas de carvao do Black Country britanico estacionaram a 7,0 por mil trabalhadores entre 1838 e 1851-3. Aqui os investimentos de prevencao de explosoes que foram tao eficazes no Nordeste da Inglaterra teriam tido pouco efeito, ja que se trata de uma regiao virtualmente desprovida de gas. Em 1838, 0,9 trabalhadores por mil morreram devido a explosoes. A principal causa de acidentes da regiao, definida em termos tecnicos, foi o desabamento. Em 1838, 3,6 trabalhadores em mil morreram devido a esta causa e, em 1851-3, esse indice havia subido para 4,1. Apesar disso, nao foram feitos investimentos para reduzir os acidentes tecnicamente definidos dessa maneira.

Na industria nuclear, Perrow opõe aos acidentes por falha de componentes mencionados acima outro tipo chamado por ele de acidentes de sistemas. Estes se iniciam com uma falha de componentes. Em seguida ocorrem falhas multiplas que interagem de formas não-previstas pelos planejadores de sistemas e por aqueles treinados para operar os sistemas. Para E.W. Hagen, editor da "Nuclear Safety", esta e a área que concentra os maiores problemas. No entanto, os especialistas em acidentes não estão investindo em tentativas de reduzir esse tipo de acidente (28).

O efeito de desigualdade de investimento ocorre quando alguns processos ou locais de trabalho são submetidos ao efeito de investimento eficaz e outros ao efeito de não-investimento (ou mesmo a investimentos não-eficazes). O resultado é a desigualdade nesse plano em termos da produção de acidentes.

No trabalho de Hair, a evolução dos indices de acidentes no Black Country comparada ao Nordeste da Inglaterra constitui um exemplo desse efeito.

A industria nuclear apresenta a capacidade de produzir desigualdade entre usinas mais suscetiveis a falhas de componentes em relação a outras mais vulneráveis a falhas de sistemas.

O efeito do novo investimento ocorre quando investimentos numa medida de segurança levam à produção de tipos de acidentes inexistentes antes, ou a um aumento nos indices de acidentes relacionados.

Em 1835, a "Select Committee on Accidents in Mines" descobriu que o uso da lanterna Davy fazia com que os mineiros fossem forçados a trabalhar em locais onde antes se recusavam, devido ao excesso de gás. Em consequência disso, o risco de asfixiação aumentou ao mesmo tempo que o risco de explosões por gás diminuiu (29).

O balanço feito por Perrow na industria nuclear esta cheio de exemplos desse tipo de efeito. Citando apenas um deles: os trabalhadores da usina nuclear norte-americana Three Mile Island foram levados a acreditar que o processo estava num estado quando, na verdade, estava em outro. Foram assim introduzidos novos erros no sistema. "Eles acharam que estavam evitando um LOCA ["loss of coolant accident", acidente por perda de refrigeração] quando, na verdade, o acidente estava ocorrendo e eles o estavam tornando pior".

O efeito do novo acidente por frequentemente ter sua origem em outro efeito: o abalo das noções que o trabalhador tem da verdade e da justiça. Em relação ao termo "verdade", isso significa que a capacidade do trabalhador de ter acesso ao conhecimento sobre sua tarefa e limitada. Quanto ao termo "justiça", sua avaliação de que tipo de tarefa deve ser realizada ou recusada não e feita de forma autônoma. O abalo dessas duas noções leva à produção de erros.

Os mineiros contestaram o uso da lanterna Davy alegando que envolvia uma perda de sua autonomia para

decidir, em função de sua tradição cultural, a respeito dos riscos envolvidos no trabalho.

Na usina de Three Mile Island, vemos que as funções do trabalho estavam planejadas de tal modo que era negado aos trabalhadores a possibilidade de construir visões claras e unificadas dos riscos envolvidos em seu trabalho. Por causa disso, eles muitas vezes agem sem o conhecimento adequado, o que constitui uma fonte constante de risco.

3.4 Cruzando perspectivas

Como Perrow, Hirschorn examinou a indústria nuclear. Concluiu que os tipos de planejamento do trabalho que negam ao trabalhador acesso a visões totais de suas funções são, nas industrias complexas, perigosos. Ele recomenda que a prevenção seja concebida segundo princípios sócio-técnicos (30). Nos termos empregados na teorização sociologica dos acidentes -o mundo do trabalho deve sempre ser estruturado de forma a garantir que os trabalhadores tenham acesso à verdade, em outras palavras, que tenham qualificações adequadas e estejam livres da desorganização.

Tal ponto de vista e encontrado também na ergonomia e medicina (31). Há a idéia embrionária de que a base da segurança do trabalho deve ser construida a partir dos significados que os trabalhadores atribuem a seu trabalho. Desse ponto de vista, espera-se a construção de um diálogo entre as analises de diversas disciplinas e as analises, interpretadas via uma teoria sociológica, que os trabalhadores fazem de suas proprias ações. Explicações validas são construidas só quando são obtidas o que Alfred Schultz chama "adequação causal" e "adequação do significado".

As disciplinas ligadas à administração da segurança estão gradualmente percebendo a necessidade de se referir aos significados que os trabalhadores atribuem a suas ações (32). Essa reorientação, como já foi visto, é fruto da crise que estão atravessando as disciplinas que constituem a pedra de toque da administração da segurança.

No campo acadêmico, Nelkin & Brown, Perrow e Lucas (33) estão entre os autores que, em tempos recentes, voltaram sua atenção a essa questão. Ao faze-lo, eles levantam questões sobre a adequação -do ponto de vista das ciências naturais- de significados que se tem dos riscos químicos, dos limites das capacidades cognitivas humanas. Ao faze-lo, a psicologia cognitiva, a biologia e a neurofisiologia são levadas a opinar sobre essa questão. As soluções de curto prazo sugeridas por esses autores para os problemas do trabalho pos-industrial -dos quais os acidentes do trabalho são apenas um- apontam para um reforço dos padrões relacionados às dimensões do trabalho ligada à medicina, engenharia, psicologia e ergonomia. São exigidos "investimentos eficazes". No entanto, num lapso extraordinário, os "efeitos perversos" estão completamente ausentes dessa análise.

A solução de médio prazo implicita no trabalho desses autores é que o problema da segurança e dos acidentes venha a ser encarado de uma forma diferente. O surgimento do trabalho pós-industrial modificou de forma consideravel a compreensão que se tem do trabalho industrial, levantou novos problemas, promoveu novos diálogos interdisciplinares e permite que o velho venha a ser visto através de novas lentes. Em raras áreas essa

renovação é tão visível quanto na da saúde e acidentes do trabalho. O "efeito do pavor" levou a população norte-americana a resistir à implantação de certas indústrias. O custo potencial dos acidentes dessas indústrias tem suscitado preocupação entre seus administradores. As disciplinas são forçadas a lidar com problemas de natureza diferente da dos encontrados no trabalho industrial e os políticos vêem-se obrigados por essa nova turbulência a votar importantes medidas para garantir o controle político sobre a questão dos acidentes. É dentro dessas novas orientações interdisciplinares por um lado, e das recentes abordagens dos problemas por parte dos sociologos, por outro lado, que esta sendo forjado um caminho em direção a novas soluções para um velho problema.

4.0 Metodologia

A partir do momento em que minha teoria sociológica dos acidentes do trabalho foi construida e aplicada com sucesso à sociedade industrial, adotei como método de trabalho o exame do passado. Quase todo esse trabalho foi realizado no "berço da civilização industrial", a Inglaterra. Isso por causa da tensão constante entre as forças sociais que representavam a ordem e a mudança, e também porque o mundo que não se sabia ainda o avatar da civilização industrial formava-se sem referência a outros modelos. Tudo isso fez da Inglaterra um campo de pesquisas muito rico acrescido, neste caso, de um meio intelectual privilegiado através do grupo History Workshop, pude entrar em contato com historiadores-sociologos que trabalhavam com problemas muito proximos aos meus. O estudo desse objeto e nesse

meio trouxe novos conhecimentos sobre a sociedade industrial atual (34). Mais recentemente, tornei-me sensivel ao fato de que esses conhecimentos podem ajudar a "compreender "os acidentes do trabalho de amanhã" (35).

O convite ao programa Science, Technology and Society da Universidade de Cornell inverte essa lógica do método do passado. Os Estados Unidos são "o berço da civilização pós-industrial". Novas formas de acidentes surgem nesse país antes de aparecerem em sociedades menos avançadas. O mundo político tenta administrar as novas tensões, enquanto o mundo científico procura entender e ajudar a resolver os novos problemas. O que é muito forte no meio científico é a reflexão multi-disciplinar sobre o assunto. E, na sociologia, tem aumentado as referências ao estudo dos trabalhadores da mesma forma que vem se intensificando as tentativas de entender, delinear os limites e mudar os sistemas de representação do trabalho. É nesse contexto que pretendo acompanhar seminários gerais sobre a questão da ciencia-tecnologia e sociedade, discutir com pesquisadores em areas correlatas, ter acesso a novas bibliografias, apresentar seminários e escrever. Acredito que esse contato com o "mundo dos problemas de amanhã" deve ajudar a perceber

(i) outras maneira de evitar esses problemas

(ii) novas maneiras de evitar os problemas do trabalho industrial.

Embora esse convite tenha vindo de Cornell, não pretendo limitar meus contatos aos pesquisadores dessa universidade. Na costa leste destacam-se, além da Wharton School da Universidade da Pensilvania e da Clark University em Massachusetts -onde existem equipes trabalhando nessa area- indivíduos nas universidades de

Yale e Nova York. Tenho tido ao longo desses anos de pesquisa na área dos acidentes do trabalho bons contatos com pesquisadores canadenses e do Sul e Oeste dos estados Unidos que pretendo aprofundar, aproveitando a oportunidade da viagem. Por último, haverá nessa época diversos congressos de meu interesse, destacando-se o da Society of Risk Analysis (em San Francisco, no mês de novembro), o da National Safety Association (em Chicago, outubro), o da American Historical Association (San Francisco, dezembro) e o da Industrial Relations Research Association (dezembro). Devido a conjunção de todos esses fatores, este convite representa uma oportunidade extraordinária de mergulhar num meio vital e uma tentativa de chegar a uma melhor compreensão de um problema que, conforme saliento na introdução desse projeto de pesquisa, custa ao Brasil 4% do Produto Nacional Bruto e causa a morte de pelo menos 4 mil brasileiros ao ano.

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Industrial Accidents are Produced by Social Relations of Work: A Sociological Theory of Industrial Accidents

Tom Dwyer
Universidade Estadual de Campinas
Adrian E. Raftery
University of Washington

ABSTRACT

Industrial accidents are produced by social relations of work. This sociological explanation of accidents is very different to the hypotheses on which nearly all modern safety practices are based, which reduce accident causes to unsafe acts and unsafe conditions. Accidents are produced at each of the three levels of social relations of work (rewards, command and organisation), and also non-socially at the individual-member level.

The resulting hypotheses were tested using data collected in seven plants according to a semi-experimental design in which shift (day/night), shift type (rotating/fixed), technological type and management styles were the factors. Our sociological hypotheses were found to have more explanatory power than competing, conventional; ones.

We conclude that effective accident prevention is produced by workers who exercise auto-control at all levels and by management which, in the absence of worker orientations favourable to auto-control, engages in safety management as defined sociologically. A practical consequence is that modifications to plant, equipment and processes will be suggested only when their interaction with the work relations is understood.

Tom Dwyer is Assistant Professor, IFCH-DCS, Universidade Estadual de Campinas (UNICAMP), Caixa Postal 6110, 13081 Campinas SP, Brasil. Adrian E. Raftery is Associate Professor, Departments of Statistics and Sociology, GN-22, University of Washington, Seattle, WA 98195, USA. Raftery's research was supported in part by the National Science Foundation under Grant no. SES-8615541.

INTRODUCTION

The ideas that theoretical advances are necessary in the treatment of industrial accidents and that existing systems of analysis are in crisis are two sides of the same coin. The prevalence of these notions is illustrated in safety engineering (Kletz, 1980), psychology (Wigglesworth, 1978; Sass and Crook, 1981), industrial medecine (Berlinguer, 1983) and government intervention (Smith, 1979), to take just four areas.

Demands for the setting of government standards and cost-benefit analysis provide new challenges both in terms of the performance of ergonomics and of its ethical position vis-a-vis those whom it directly affects - workers. The discipline has not been immune to the idea that major theoretical advances are needed: in both Britain and France it is suggested that a "crossroads" has been reached (Davis, 1983; de Keyser, 1984), and Singleton (1982) goes so far as to see the necessity for "radical new thinking."

Localised attempts to formulate new thinking exist. Because of his research on technology transfer, Wisner (1981, 1985) is forced to move outside traditional French ergonomics perspectives to advocate a new area of multi-disciplinary study called anthropotechnology. On the basis of an analysis of failures in high technology systems, Perrow, a North American sociologist, suggests (1983) that human factors engineering turn its attention to a range of factors, especially social ones, that influence work performance. These efforts appear as forebears of what may, one day, became a major force for renewal in the discipline - its integration of a sociological perspective. Such an integration is related to what Edgar Morin has seen as one of the major theoretical challenges of our age - the establishment of links between the hitherto separated natural and social sciences.

Industrial accidents are produced by social relations of work. This hypothesis underlies our sociological reflection on the production of accidents. It is radically different to the hypotheses on which nearly all modern safety practices are based, which reduce accident causes to unsafe acts and unsafe conditions. A sociological theory of accidents has two "moments". In the first the workplace can be seen as made up of a series of "givens" - materials, machines, processes,

product markets, a labour force and so on - that are formed by the working through of social relations external to the workplace. These can be changed only by alterations in the relations that produce them, or by introducing different sets of "givens" into the workplace. In a second moment, within the workplace, these "givens" are assembled and managed in a process that produces goods, services and industrial accidents. It is this second moment that we shall discuss.

In this article, we first bring together some elements of a sociology of work, and introduce some studies that confirm the utility of the categories developed and build hypotheses to be tested. We then describe a method with which to test the theory and a semi-experimental study design. The data obtained is modelled statistically, and the sociological hypothesis is found to have greater explanatory utility than other conventional ones. The reader is then briefly introduced to qualitative data from the plants researched. Some implications of this analysis for ergonomics are drawn in a conclusion.

A SOCIOLOGICAL THEORY OF INDUSTRIAL ACCIDENTS

There are three levels of social relations of work: rewards, command and organisation. A social relation is the mannner in which the relationship between people and their work is managed. In addition, accidents are produced non-socially at what we shall call the individual-member level.

Each level of social relations obeys the same internal dynamic: employers and employees are engaged in conflict for control of the level. Through this conflict, and its resolution, the firm produces goods and services. Undesirable results, such as accidents or abseenteeism, are produced by complex articulations of the same relations, each requiring its own set of theorisations. Within each level employers or workers may intervene to limit the undesirable effects of the functioning of that or other levels.

The levels are interrelated: a change in one might change the way another one works, with effects on production, absenteeism, accidents and so on. At each level, questions are raised about knowledge of dangers, orientations towards acting with these, and the collective power to resist

danger and doing dangerous work. Employers try to ensure performance by offering incentives, by using power, by controlling the production and distribution of knowledge, and by other means. Workers respond favourably to some such strategies and, at the same time, may develop their own strategies in an attempt to control the job. When action aimed at increasing industrial safety is engaged in by management it is called employer safety management. When exercised by workers it is called auto-control. Depending on the level at which it is exercised, auto-control can also be called auto-rewards, auto-command or auto-organisation, and employer safety management can, likewise, be linked to the levels at which it is practiced.

At the rewards level work is produced through the manipulation of payments, whether monetary or symbolic, in return for work effort, whether through an intensification of work, e.g. piece payments, or through its extension, e.g. overtime.

At the command level work is produced through the use of power. This may be overt and resisted, e.g. authoritarianism, or covert and accepted, such as when risks are accepted as a normal part of work. The functioning of this level to the benefit of employers is guaranteed only by the absence of collective action capable of opposing the employer's use of power; the basis of this guarantee is the absence of work group integration.

At the organisational level work is produced through employer control over the division of labour. This translates into task structure, relationships between tasks, task demands, the knowledge workers have of these, and their capacity to react independently of the influence of social relations at other levels.

The individual-member level refers to the extent to which the worker is not organised, commanded or rewarded. It is made up of the autonomy that remains to the workers after the working through of the social relations to which they are submitted.

The present study is an application of a more general theory of the production of undesirable consequences of the functioning of social relations in organisations. Research using it is currently being conducted in two other areas: medical failure and educational dropouts. Details of the theoretical construction are given elsewhere (Dwyer, forthcoming).

A sociological interpretation of the industrial accidents literature

The rewards level is seen in the literature as producing accidents through financial incentives, long working hours, symbolic rewards, incapacity of poorly nourished workers to perform tasks in safety. No one of these factors by itself necessarily causes accidents, and effects may be differentiated by sector or factory. One Canadian study showed, for example, no link between financial incentives and accidents (Mason, 1977). This result seems in conflict with a study of Swedish mines and logging, where reductions in accident rates ranged from 30% to 95% after the abolition of financial incentives (J. Kronlund, 1973; anon, 1977). This difference is more apparent than real since for incentives to be effective, people must be oriented to work harder to earn them, and for incentives to produce more industrial accidents, greater risks must be taken to earn them. It is not the incentive as such that produces accidents but the reactions of workers when faced with these. The incentive may be symbolic rather than financial (Haas, 1977; Freilich, 1970).

Also at the rewards level is the relation of extended work: people work longer than is safe or work beyond their physical capacities and, as a result, have an accident. However, job demands differ between sectors and workers have different capacities. One illustration is provided by Solins (1976). He calculated that an increase of one hour in the working day results in a 30% rise in accidents in the metalworking sector, but no significant increase in the construction and clothing sectors. The accident rate of a predominantly Muslim group of construction workers in France went up by about 40% during the Ramadan fast (Grand and Laurent, 1969). Clearly, a management strategy to change work scheduling during Ramadan to take account of such reduced capacities would have a role to play in reducing accidents. In one spectacular example, an increase in the work week from 60 to 72 hours was associated with a two and a half times increase in accidents (Vernon, 1918). Other research results link reductions in working hours to declines in accident rates.

The command level is not seen in the safety literature as having an important weight in accident production. Workgroup disintegration has been seen in a German study to be

responsible for 10% of accidents in three steelworks (Neuloh *et al.* 1957) and 5% of fatal construction accidents in a Parisian sample (Wisniewski, 1977). Greater workgroup integration, whether sponsored by employers or workers, could be expected to result in a reduction of the associated accidents. The acceptance of danger as a natural part of the task is seen in some management oriented literature as a problem to be overcome (anon, 1982; Watson, 1986) and has been identified as a factor in the production of accidents by sociologists (Hopkins, 1984; Edwards and Scullion, 1982). In the absence of workgroup integration, frequently formalised as union power, the employer resort to authoritarianism can be facilitated. For Carson (1982) employer action has contributed to the ineffectiveness of unions on the British North Sea Oil fields thereby contributing to the production of their high accident rate. Subsequent to the dismissal of an automobile factory's shop stewards, Turner *et al.* (1967) reported an increase in accidents. In British coal mines, Hill and Trist (1955) tentatively attributed the reduction of accidents on night shift to there being less "authority" on this shift or, in the terms used here, to a rise in employee auto-command.

Social relations at the organisational level produce the majority of work accidents in advanced industrial nations. The monotony and boredom associated with routine work has been seen as responsible for accident production (Caillard, 1976; Raymond, 1952). Job rotation and enlargement are strategies adopted, formally or informally, to reduce the weight of routine. Increasingly, disorganisation appears to be built into the more complex industrial and work processes; it can be seen as being at the origin of the Three Mile Island and the Challenger accidents (Perrow, 1984; Rogers, 1986). The traditional notion of "good housekeeping" expresses an idea of the absence of one form of disorganisation and that of "routine maintenance" embodies an employer strategy to avoid the delays and dangers that issue from another form. Disorganisation may produce demands on workers to perform corrective tasks for which they are inadequately trained. Non-usual tasks occupying 5% of worktime were found by Trautes, as reported by Faverge (1967), to be responsible for 60% of accidents. The role of underqualification in ordinary work settings has been examined: accident victims were found to

have considerably less experience than non-victims working at matched tasks (Powell *et al.*, 1971). A Swedish study produced a similar result (Hagbergh-Olycksfall, 1960). The literature review of Ellis (1975) reported little evidence to support the claim that training reduces accidents. However, training has been thought to play a large part in accident prevention (Quinot and Moyen, 1980). Consistent with this, North American studies report reductions in accidents by 50% in the chemicals and pulp and paper industries (Collisson, 1964; US Bureau of Labour Statistics, 1971).

It has been claimed that the individual-member level causes accidents through accident proneness, individual carelessness and differentiated cognitive capacities. It seems unlikely that this level, on its own, accounts for many accidents.

Hypothesis formulation

We hypothesise that the management of workers' relationships to the dangers of the job through social relations at a given level will be associated with the production of accidents at that level. This is the key hypothesis that underlies our sociological approach. It implies that a reduction in the weight of a given level will be associated with a reduction in accidents at that level. Also, an increase in the weight of a level will be associated with a rise in accidents at that level. In addition, strategies, whether employer or employee promoted, that reduce the weight of social relations at a given level will be associated with reduced accident production at that level.

The hypothesis that auto-control and employer safety management reduce accident rates leads to two propositions. These will be compared with hypotheses drawn from other perspectives to see if they have utility for explaining observed drops in accident rates.

METHOD AND DESIGN

The research is based on a case study approach and the use of mixed methods: semi-participant observation of the workplace, semi-structured interviews with staff at all levels and the analysis of company records. Such an approach to the study of work is a classical one for the

social sciences but a rare one for the study of accidents (Faverge, 1967; Le Plat, 1978). Data gathered by one method is checked against that gathered by another in a process called triangulation (Denzin, 1970). Explanations are considered valid only when they exhibit causal and meaning adequacy (Shutz, 1967).

Research took place in seven shiftwork factories. Shiftwork was chosen because it constitutes a semi-experimental form of work in which, when it involves rotating schedules, workers, machines and materials stay the same between shifts. Given this control, any observed changes in accident rates have, necessarily, to be explained in terms of factors that exclude reference to the items controlled for. In fixed shift schedules, machines and materials are controlled for. The literature on shift work contains contradictory results and reveals no intrinsic link between night and day shifts and accidents (Smith, 1979). Five of the plants chosen had rotating shifts and two had fixed shifts.

These plants were also chosen to represent certain technological types and management styles. Technologically the dominant production systems run from (a) semi-artisanal, through (b) semi-mechanised, to (c) continuous process production (Touraine, 1962). Management styles were of three types: (1) compacted management, in which employers did not resort to the use of the rewards level to intensify work and workers exhibited strong collective organisation at the command level; (2) traditional management, in which employers managed via incentive systems at the rewards level and workers were not collectively organised at the command level; and (3) induced management, in which employers managed via incentives at the rewards level and workers were strongly organised at the command level. Table 1 locates the plants and their variations in accident rates.

Table 1
Characteristics of plants and variations in accident rates (in accidents per 100,000 man shifts)

	Technological type		
	Semi-artisanal	Semi-mechanised	Continuous process
Compacted management	Plant A day=103 night=75	Plant C day=63 night=30	Plant B day=43 night=33
Traditional management	Plant D day=103 night=191	Plant E day=26 night=63	
Induced management		Plant F day=32 night=74 Plant G day=40 night=16	

STATISTICAL MODELLING: CONVENTIONAL AND SOCIOLOGICAL EXPLANATIONS COMPARED

Data

For each shift (day/night) in each of the seven plants, 31 variables that have been hypothesised to affect accident rates were recorded. The variables that appear in our final model are shown in Table 2. A full listing of all the variables in contained in the Appendix.

The first variable is danger of materials, x_1. The physical danger of the plant was also assessed, but it was highly correlated with x_1 and thus contributed little additional predictive power; the same was true of the number of safety devices. Thus, here we are taking x_1 as a general measure of the intrinsic danger of the work, or overall danger level.

Table 2
Variables for the study

Plant	Shift	Total shifts	Shifts w/acc.	Acc. rate	Danger level x_1	Auto-control x_2	Org./Rew. levels x_3	Command level x_4	x_5	x_6
A	Day	20402	21	103	7	2	2	2	0	0
	Night	18629	14	75	7	1	1	1	1	0
B	Day	23237	10	43	3	2	2	2	0	0
	Night	18134	6	33	3	1	1	1	1	0
C	Day	15836	10	63	5	2	2	2	0	0
	Night	13197	4	30	5	1	1	1	1	0
D	Day	2915	3	103	6	2	1	2	0	0
	Night	2098	4	191	6	2	2	1	0	1
E	Day	7717	2	26	4	2	1	2	0	0
	Night	4790	3	63	4	2	2	1	0	1
F	Day	28232	9	32	1	1	1	2	0	0
	Night	18821	14	74	1	2	2	1	0	1
G	Day	47641	19	40	2	2	2	2	0	0
	Night	38247	6	16	2	1	1	1	1	0

NOTE: The variables are defined as follows:
Shifts w/acc. = number of shifts with at least one accident
Acc. rate = number of accidents per 100,000 man shifts
x_1 = danger of materials ranked among plants (1=low, 7=high)
x_2 = auto-control; see text (1=high, 2=low)
x_3 = weight of organisational and rewards levels (1=low, 2=high)
x_4 = weight of command level (1=low, 2=high)
x_5 is defined by equation (1)
x_6 is defined by equation (2).

Evidence from the case studies confirms the hypothesis relating to auto-control of all levels by workers. The key factor associated with declines in accident rates appears to be auto-command. Where it exists, accident rates are reduced because it reduces the weight of other levels of social relations. Empirically, auto-control is exercised via auto-command which affects other levels when employer power at the command level is reduced. Plant F day workers exercise auto-rewards without exercising auto-command and this is associated with a reduction

in their accident rates. These different situations are aggregated under a specially developed variable: auto-control, x_2. A simple rise in auto-control does not, a priori, lower the accident rate, and it may be associated with a countervailing increase in the weight of certain social relations.

The weights of the organisational and rewards levels, x_3, were the same for each plant and shift so that we cannot distinguish between their effects. Also, the command level, x_4, was high on the day shifts and low on the night shifts so that we cannot distinguish between command level and time-of-day effects.

These are not problems for us, however, because our hypothesis does not predict that x_2, x_3 and x_4 affect accident rates independently. The hypothesis can be more precisely stated as follows. In a given plant, if the weight of the command level decreases, the best predictor of what will happen at all other levels (other than the individual-member level) is auto-control, x_2. If this is high and is associated with an overall decrease in the weight of the rewards and organisational levels, a decrease in accident rates will be produced. A variable x_5 has been built to allow this hypothesis to be tested. This is defined as follows:

$$x_5 = \begin{cases} 1 & \text{if } x_2=1, x_3=1 \text{ and } x_4=1 \\ 0 & \text{otherwise} \end{cases} \qquad (1)$$

In these case studies, employer safety management is indistinguishable from employer command level control as measured by x_4. It could be hypothesised that when this is high, domination at the organisational level, the rewards level, or both will decrease and this will produce a decline in accident rates. The evidence in Table 2 does not support this hypothesis. This could lead to a preliminary interpretation that safety management, in its sociological sense, does not have any general effect on the reduction of accident rates. However, such a judgement is too hasty.

Empirically the studies revealed a complex link between the absence of employer command level safety management and the absence of auto-control. In the cases where these two

coincide a rise in accidents was observed; this observation allows the hypothesis relating to employer safety management to be reexamined. Where workers are unwilling or unable to exercise auto-control, it can be hypothesised that managerial safety management at the command level plays an effective role in accident reduction.

In a given plant, if employer control at the command level, x_4, decreases, the best predictor of what will happen at other levels, except the individual-member level, is auto-control, x_2. If x_2 is low then the weight of the rewards and/or organisational levels, x_3, increases. If the overall weight of both levels rises to a greater extent than the decline produced in the weight of the command level, the accident rate rises. A variable, x_6, has been generated to allow this hypothesis to be tested. It is defined as follows:

$$x_6 = \begin{cases} 1 & \text{if } x_2=2, x_3=2 \text{ and } x_4=1 \\ 0 & \text{otherwise} \end{cases} \qquad (2)$$

Statistical modelling

Let the probability of an accident in a given shift at a given plant be p. Then our model is the logistic regression model of Cox (1970), namely

$$\log\left[\frac{p}{1-p}\right] = \beta_0 + \sum_{i=1}^{m} \beta_i x_i, \qquad (3)$$

where $x_1, \ldots, x_m$ are independent variables and $\beta_0, \beta_1, \ldots, \beta_m$ are unknown parameters that have to be estimated from the data. This is best done by the method of maximum likelihood, which is implemented in the GLIM computer program (Baker and Nelder, 1978); see also McCullagh and Nelder (1983). This also yields tests via the sampling distribution of the deviance of the fitted model. The deviance is a generalisation of the residual sum of squares in linear regression.

We adopt a stepwise approach to choosing the independent variables in equation (3). To select the first independent variable for inclusion in the model, we fit a model with each of the 33

candidate independent variables individually, and choose the one which most reduces the deviance, provided that the reduction is significant. The variable which fits best is x_1, danger level, which reduces the deviance by 41% for one degree of freedom (the % reduction in deviance is a generalisation of R^2).

To choose the second independent variable for inclusion in the model, we fit a model with each of the remaining 32 variables together with x_1, choosing the variable that reduces deviance the most from that left by x_1 alone. The variable that reduces deviance the most is x_6, followed closely by x_5. The variable x_6 reduces the deviance by half, to about 30% of its original value. Because x_5 and x_6 are complementary variables from the same theory, we next include x_5, which again reduces the deviance significantly.

The resulting model fits better than any other combination of two or three of the 33 possible independent variables (provided that x_1 is included and that if x_5 is included so is x_6). It has a generalised R^2 of 0.85, revealing the power of the sociological explanation. The entire modeling process is summarised in Table 3 and the model predictions for each individual plant and shift are shown in Table 4. None of the individual differences between actual and predicted numbers of accidents is significant. Thus the model, which summarises the entire data set with only four parameters, fits the data well.

Table 3
Model-fitting results

Model	Deviance	Degrees of freedom	% of deviance explained (R^2)
All plants same	38.5	13	0
x_1	22.6	12	41
$x_1 + x_6$	11.4	11	70
$x_1 + x_6 + x_5$	5.6	10	85

Table 4
Number of accidents predicted by the model compared with the actual number

Plant	Shift	Number of accidents	
		Actual	Predicted
A	Day	21	21
	Night	14	11
B	Day	10	10
	Night	6	5
C	Day	10	11
	Night	4	5
D	Day	3	2
	Night	4	4
E	Day	2	4
	Night	3	6
F	Day	9	8
	Night	14	12
G	Day	19	17
	Night	6	8

The estimated parameters are shown in Table 5, together with their standard errors. All the parameters are highly significantly different from zero. We can interpret the model as follows:

(i) increasing x_1 by 1 increases p, the probability of an accident, by a factor of $e^{.21} = 1.23$, i.e. by about 23%;

(ii) increasing x_5 by 1 (i.e. going from a situation where $x_5 = 0$ to one where $x_5 = 1$) reduces p by a factor of $e^{-.51} = 0.60$, i.e. by about 40%;

(iii) increasing x_6 by 1 increases p by a factor of $e^{.75} = 2.11$, i.e. it more than doubles p.

The results confirm our hypothesis rather strongly. In a plant subject to a given level of risk - a product of the "givens" assembled from outside - effective accident prevention is produced by workers who exercise auto-control at all levels and by management which, in the absence of worker orientations favourable to auto-control, engages in safety management as defined sociologically.

Table 5
Parameter estimates for the fitted model

Parameter	Estimate	Standard error
Intercept	-8.34	
x_1	.21	.04
x_5	-.52	.22
x_6	.75	.25

THE CASE STUDIES: A QUALITATIVE TREATMENT

Between plants run under the same management style or using technologies of similar types considerable variations can be found. Some of these are quantified in Table 2 and in the Appendix; see also Dwyer (1981). Here a brief overview of similarities and differences will be given.

In none of the plants researched was the command level responsible for the production of the majority of accidents. Authoritarianism played an important role in the traditional management style. In the unionised plants it was used occasionally, and notably in breakdown situations in plants without incentive systems where it forced a prompt return of production. Management power functioned, almost universally, to reduce worker autonomy to act in terms of orientations developed in reaction to the rewards and organisation levels. In some plants, particularly those subject to traditional management, dangers had come to be accepted as normal; this directly produced diverse accidents such as cuts and burns. Workgroup disintegration, although seen as a potential source of danger in all except plant F, did not directly produce accidents in all.

In plants A, B and C, in spite of the different technologies used, the drop in accident rates observed at night was always explained as being a result of reduced employer command pressure. From a sociological viewpoint such a reduction does not necessarily lead to a decline

in accidents - it must be accompanied by appropriate changes in social relations. In these plants workers were both "safety conscious" and well organised in defense of their interests. At night, they resorted to auto-command, leading to an increase in their refusal to work in situations defined as dangerous and a decline in employer resort to authoritarianism. More importantly it articulated into other levels.

At the rewards level extended work represented a potential problem in all plants. However, different employer policies resulted in differentiated potential effects of this relation. In the three plants with a compacted management style, union pressures had lead to managerial decisions to replace absent workers by placing other workers on a double shift. In the plants subject to traditional management the absence of strong unions permitted short staffing to be used to bridge those gaps produced by absentees. In the remaining plants employers were able to resort to strategies unavailable elsewhere and they reacted to union demands for adequate staffing mainly by shutting down individual machines. Extended work would appear to have the greatest importance in plants subject to compacted management.

On night shift workers in plants A, B and C resorted to auto-rewards, taking advantage of the reduction in employer command power. Overly tired workers were spelled informally by colleagues, a practice prohibited by management on day shift.

Financial incentive systems were used in four plants. In rotating shift plants D and E workers were highly motivated by the incentives and inter-shift competitions; to reduce the negative effects of their actions employers resorted to command level safety management on day shift. When employer command pressure was less, workers on night shift could be seen and acknowledged taking greater risks to increase production levels, unlike their counterparts subject to compacted management. Workers' natural tiredness on night shifts coupled with the inexistence of any system, formal or informal, to spell overly tired workers also contributed to increase rewards level produced risks on this shift.

Plants F and G, subjected to the same management style, show contradictory patterns of accidents between shifts. This is intimately linked to characteristics of fixed shifts -

differentiated staff displays different orientations and capacities when confronted with similiar changes in managerial control of social relations.

Plant F fits into the pattern already discussed. In spite of a generally high level of safety consciousness, night shift workers took risks in the absence of employer command power, and to an extent determined by their orientations to financial incentives. Day shift workers were on average older and, having already achieved a certain degree of financial security, were less favourably oriented to earn them than their younger night colleagues, independently of the increased managerial control on this shift. This is consistent with the results of Lindstrom and Sandstrom-Fisk (1976). Other rewards level relations did not vary between shifts.

In spite of greater managerial command level presence, plant G day workers took greater risks because they were more favourably oriented towards the bonus system than their night counterparts. Task requirements were such that experience and ability, rather than effort, were the important ingredients in bonus earning. Recognising this, the more experienced day workers displayed a more favourable orientation to bonus earning than their night colleagues. A relatively strong sense of safety values was present on both shifts, and these articulated into auto-rewards and safer work performance only at night.

Underqualification presented itself in various forms and in varying degrees. It was most common where high labour turnover cooexisted with demands that a worker perform a large number or complex set of tasks. Formal training programmes were linked by interviewees to reductions in the relation's potential in some plants. Disorganisation because of breakdowns proved to be particularly chronic in plant C on day shift, minimal in plants E and F and varied between these extremes in the other plants. Routine was not a feature of the principal production tasks in the plants with a semi-artisanal process type or in plant E, where a large variety of products are made and the labour turnover rate is high. Elsewhere its weight in accident production varied; it was not seen as having an importance close to that of other organisational level relations. The organisational level dominated the production of accidents in all plants researched. On night shift underqualification increased thus raising the weight of the

organisational level in plants D and E. This occurred because, in the absence of active unions, managements moved workers up the job hierarchy to cover for absentees, so that inadequately qualified people were placed in jobs. Absenteeism was more common on the night shift, so that the weight of underqualification on this shift increased.

In plants A, B and C auto-organisation took place through strategies such as the rotation of routine tasks and the correction of disorganisation. The weight of organisational level relations declined as a result although in plant B the decline was less pronounced than in plants A and C.

On night shift in plant F the organisational level's weight increased since workers repaired their own machines to counter inadequate maintenance, thus producing underqualification. It was thought that task monotony combined with night work would produce more accidents, but this could not be validated.

In plant G routine appeared to be higher on day shifts because the workers were more accustomed to their tasks than their less senior night shift counterparts. In addition, the company promotion structure placed the longer serving workers in the most skilled and heaviest jobs. An articulation between the organisational and individual-member levels was thus produced which resulted in numerous back injuries to the most skilled day shift workers; their younger night time counterparts suffered less such injuries.

The individual-member level was important for accident production only in plant G where, linked to the organisational level decision to allocate older workers to the most senior and heavy jobs, it provoked a large number of back injuries. In other plants its importance rose slightly on night shift but the rise was insufficient to produce observable effects on accident production.

The case studies, reported here in a highly simplified form, have shown the complexity of the causal relations between the levels. The notion underlying the sociological theory of industrial accidents, that accidents are to be seen as products of social relations and to be prevented by changing these relations, was validated in these case studies. Specific changes in accident rates were explained by specific transformations in social relations. Competing non-sociological notions of cause and prevention were modelled statistically and seen not to exhibit

the same explanatory power.

IMPLICATIONS FOR ERGONOMICS

In one of the pioneering studies of safety expenditure using cost-benefit analysis, Rinefort (1977) suggested that "the most effective mix ... would seem to be a balanced approach which combines both engineering and non-engineering and probably puts more emphasis upon the non-engineering aspects." One non-engineering approach that has shown its utility is a sociological approach. For the disciplines that seek to promote industrial safety this implies that all worker-equipment interactions be seen as mediated by social relations at the rewards, command and organisational levels.

Without increasing costs to competitive sector firms, certain changes in social relations have been shown to reduce accidents. This has two practical consequences, one methodological and one theoretical. Ergonomics should focus greater intention on workplace investigation. This idea is not new, having been advocated by the Belgian ergonomist Faverge (1967) over twenty years ago. What is new is the support of a sociological theory for this form of investigation.

Henceforth, ergonomists will be able to analyse accidents as being produced by social relations. A practical consequence of such an analysis is that modifications to plant, equipment and processes will be suggested only when their interaction with the work relations is understood. Furthermore, the investigation of the appropriateness of proposed technologies for existing or hypothesised patterns of social relations will become a basic consideration in each ergonomic intervention. The adoption of this new dimension to the discipline's analysis should enable the ergonomist's intervention to acquire a new efficiency.

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APPENDIX

Variables measured on the seven plants

The variables measured on the seven plants are shown in Table A1. They are as follows.

Variable 1. Shift. 1 = Day, 2 = night.

Variable 2. Process Type: 1 = process type (a) (semi-artisanal) 2 = process type (b) (semi-mechanised) 3 = process type (c) (continuous process)

Variable 3. Shift type. 1 = rotating, 2 = fixed.

Variable 4. Strike Rate: 1 = higher 2 = medium 3 = lower. Interview and (where available) statistical data were used to arrive at the ranking. (It represents differences between plants, and assumes identical treatment between shifts in the same plant).

Variable 5. Labour Turnover (1): 1 = higher 2 = lower, permits comparisons between shifts and between plants.

Variable 6. Labour Turnover (2): expressed in terms of the annual percentage of the workforce. eg. 3 = 30%

Variable 7. Span of Control (1): number of workers for each floor foreman.

Variable 8. Span of Control (2): number of workers for each foreman or other member of managerial staff normally located in the plant.

Variable 9. Number of Staff: the figure given is the number of workers, foremen and managers employed.

Variable 10. Potential Cost of Accidents: 1 = high 2 = medium 3 = low, the measures are relative between the plants.

Variable 11. Productivity: 1 = higher 2 = same 3 = lower, measures comparison between shifts in the same plant.

Variable 12. Age of Staff: 1 = higher 2 = same 3 = lower, values reflect the differences between shifts in same plant.

Variable 13. Finanacial Incentives: 1 = non-existant 2 = existant.

Variable 14. Control Style: 1 = compacted management 2 = traditional management 3 = Induced management.

Variable 15. Physical Danger: 1 = least dangerous 2 = most dangerous. The seven plants are ranked on the basis of a combination of observational and interview data. The overall dangers of products, processes etc. are reflected in this measure.

Variable 16. Danger of Materials: 1 = least dangerous 2 = most dangerous. The principal materials used are ranked.

Variable 17. Safety Devices: 1 = most safety devices 7 = least safety devices. The ranking is based on an assessment as to the extent to which plant or machinery design keeps workers "at a distance" from potential dangers.

Variable 19. Danger of Process: 1 = low 2 = high. a forced choice in which the relative dangers of the main production process are recorded.

Variable 20. Government Inspection: 1 = above average 2 = average 3 = below average. Interview data measuring the relative frequency of Department of Labour inspection.

Variable 21. Safety Officers: 1 = specialist 2 = non-specialist. All plants are overseen by safety officers of some type, these are distinguished by their function.

Variable 22. Safety Committees: 1 = safety committee exists and is judged (via interviews with workers) effective 2 = safety committee exists and is judged ineffective 3 = safety committee does not exist.

Variable 23. First Aid: 1 = above average 2 = average 3 = below average. A rating of differential services between both shifts and plants.

Variable 24. Union and Safety: 1 = active 2 = average 3 = inactive. This index was calculated on the basis of interview data on perceptions of union involvement in safety.

Variable 25. Qualifications: 1 = higher qualifications required to perform work adequately 2 = lower qualification is required.

Variable 26. Training: 1 = formal training schemes exist 2 = formal training schemes don't exist.

Variable 27. Worker Control: 1 = high control 2 = low control. To what extent do workers control their own work relations in terms of an orientation whereby they seek to reduce accidents?

Variable 28. Workers and Incentives: 0 = not applicable 1 = incentives offered and workers do not accept working dangerously to earn them 2 = incentives offered and workers accept working dangerously to earn them, but their actions are held in check by employer authority 3 = incentives are offered and workers act dangerously to earn them.

Variable 29. Rewards Level: 1 = lower 2 = higher, the values are relative between two shifts in the same plant. The attribution is made on the assumption that each level will dominate the functioning of work to a greater extent on one shift than on another.

Variable 30. Command level. As Variable 29.

Variable 31. Rewards level. As Variable 29.

Variable 32. Individual-Member level. As Variable 29.

Table A1

Values of the variables for the seven plants

	A day	A night	B day	B night	C day	C night	D day	D night	E day	E night	F day	F night	G day	G night
Shift: Day = 1 Night = 2 : V.1	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Process Type: V.2	1	1	3	3	2	2	1	1	2	2	2	2	2	2
Shift Type: 1 = rotating 2 = fixed : V.3	1	1	1	1	1	1	1	1	1	1	2	2	2	2
"Strike Rate": V.4	1	1	3	3	1	1	3	3	3	3	2	2	1	1
Labour Turnover(2): V.5	2	2	2	2	2	2	1	1	1	1	2	1	2	1
Labour Turnover(1): V.6	1	1	1	1	2	2	9	9	7	7	2	4	3	5
Span of Control(1): V.7	18	16	17	14	11	13	14	13	20	18	13	13	18	29
Span of Control(2): V.8	6	16	9	14	5	13	5	13	5	18	8	13	12	29
Number of Staff: V.9	42	33	38	30	39	27	17	14	25	19	44	28	78	60
Potential Cost of Accidents: V.10	1	1	1	1	2	2	1	1	2	2	3	3	2	2
Productivity: V.11	3	1	2	2	3	1	2	2	3	1	2	2	1	3
Age of Staff: V.12	2	2	2	2	2	2	2	2	2	2	3	1	3	1
Financial Incentives: V.13	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Control Style: V.14	1	1	1	1	1	1	2	2	2	2	3	3	3	3
Physical Danger: V.15	7	7	2	2	4	4	6	6	5	5	1	1	3	3
Danger of Materials: V.16	7	7	3	3	5	5	6	6	4	4	1	1	2	2
Safety Devices: V.17	6	6	1	1	4	4	7	7	5	5	2	2	3	3
Danger of Process: V.19	2	2	1	1	1	1	2	2	1	1	2	2	1	1
Government Inspection: V.20	3	3	3	3	3	3	1	1	1	1	2	2	2	2
Safety Officers: V.21	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Safety Committees: V.22	3	3	1	1	1	1	3	3	3	3	2	2	2	2
First Aid: V.23	2	1	2	1	2	1	1	3	1	3	1	2	1	2
Union and Safety: V.24	1	1	2	2	1	1	3	3	3	3	1	1	1	1
Qualifications: V.25	1	1	2	2	2	2	1	1	2	2	2	2	1	1
Training: V.26	2	2	2	2	2	2	1	1	2	2	2	2	1	1
Social Derivatives														
Worker Control: V.27	2	1	2	1	2	1	2	2	2	2	1	2	2	1
Workers+Incentives: V.28	0	0	0	0	0	0	2	3	2	3	1	3	3	1
Social Relation+I-M														
Organisational level: V.29	2	1	2	1	2	1	1	2	1	2	1	2	2	1
Command level: V.30	2	1	2	1	2	1	2	1	2	1	2	1	2	1
Rewards level: V.31	2	1	2	1	2	1	1	2	1	2	1	2	2	1
Individual-Member level: V.32	1	2	1	2	1	2	1	2	1	2	1	2	1	1

- ce qui est dans le cours | travail posté / travail à la chaîne / chaîne du travail

- ce qui manque — les 4 paths
hors socio — les aspects techniques (ERROW 3 rôles)
— les aspects économiques et
directement techniques et financiers. BHOPAC
— l'organis. et communication
(Clang etc.)

— l'action des causes ... pas
gestion des — les formations ... sociologique
- en socio ruptures d'organisation

challenger par organisation raison économique —
par des transformations antérieures autres.

Il mis — qualification
— formation
— communication | dans la sociologie
→ cognitive ... et capacités de personne.

travail, on a jamais mis (variation progressive)

doublage des postes

[régulation sociale]

DRAFT prior to final for comment - to be submitted to Applied Ergonomics (U.K.)

DO NOT QUOTE PLEASE.

Don B.

SOME SOCIOLOGICAL CONSIDERATIONS ON THE PRODUCTION OF INDUSTRIAL ACCIDENTS: theory and research.

INTRODUCTION

The ideas that theoretical advances are necessary in the treatment of industrial accidents and that existing systems of analysis are in crisis are reverse sides of the same coin. The universality of such notions is illustrated in safety engineering (Kletz, 1980), psychology (Wigglesworth, 1978, Sass and Crook, 1981), industrial medecine () and government intervention () to take just four areas.

Schlinger 1983.

Smith 1977

At a general level demands for the setting of government standards and cost benefit analysis provide new challenges both in terms of ergonomic's performance and definition of the discipline's ethical position vis a vis those who its work directly affects- workers. The discipline has not been immune to the idea that major theoretical advances are needed: in both Britain and France it is suggested that a "crossroads" has been reached () (de Keyser, 1984), and Singleton (1982) goes so far as to see the necessity for "radical new thinking."

Paris 1983

Localised attempts to formulate new thinking exist. Because of his research on technology transfer Wisner (1981, 1985) finds himself obliged to move outside of a traditional French ergonomics perspectives to advocate a new area of multi-disciplinary study called anthropotechnology. On the basis of an analysis of failures in high technology systems Perrow, a North American sociologist, suggests (1983) that human factors engineering turn its attentions to a range of features, and especially social ones, that influence work performance. These efforts appear as forebearers of what may, one day, became a major force for renewal in the discipline- its integration of a sociological perspective. Such an integration links, in turn, to what Edgar Morin () has seen as one of the major theoretical challenges of our age- the establishment of linkages between the hitherto separated natural and social sciences.

Industrial accidents are produced by social relations of work. This hypothesis underlies any sociological reflection on the production of accidents. It is radically different to those hypotheses that serve as bases of nearly all modern safety practices- which reduce accident causes to unsafe acts and unsafe conditions. A sociological theory of accidents has two "moments", in the first the workplace can be seen as made up of a series of "givens"- materials, machines, processes product markets, a labour force etc. that are formed by the working through of social relations external to the workplace. These can be changed only by alterations in those relations that produce them, or by introducing different sets of "givens" into the workplace. In a second moment, within the workplace, these "givens" are assembled and managed in a process that produces goods, services and industrial accidents. It is this second moment that we shall discuss.

This article is divided into three sections. Firstly it brings together a few elements of a sociology of work, introduces some studies that confirm the utility of the categories developed and builds hypotheses to be tested. It then describes a method with which to test the theory and details a semi-experimental study design. In a final section data obtained -which expresses both sociological and conventional hypotheses related to accident prevention in numerical form- is subjected to statistical tests and the sociological one found to have the greatest explanatory utility, the reader is then briefly introduced to qualitative data from the plants researched. Some implications of this analysis for ergonomics are drawn in a conclusion.

SECTION 1
A SOCIOLOGICAL THEORY OF INDUSTRIAL ACCIDENTS

There exist three levels of social relations of work: rewards, command and organisation. A social relation is the mannner in which the relationship between people and their work is managed. In addition, accidents are produced non-socially at what we shall call the individual-member level.

Since this article is not written for a specialist sociological audience I will not go into details of the theoretical construction, this is done elsewhere. (DWYER, forthcoming) how each of these levels is constructed. It is important to note that each level of social relations obeys the same internal dynamic: employers and employees are engaged in conflict for control of the level. Through this conflict and its resolution the firm produces goods and services. Undesirable results, such as accidents or absenteeism, are produced by complex articulations, each requiring its own set of theorisations, of the same relations. (The theory built here is a specifically applied version of a much more ambitious theory, the production of undesirable effects of the functioning of social relations- it is currently being applied in two other areas: medical failure and educational dropouts.) At the interior of each level employers or workers may intervene to limit the undesirable effects of the functioning of that or other levels.

The levels are interrelated, a change in one might produce changes in the functioning of another with consequent effects for production, absenteeism, accidents etc. At each level questions relating to the knowledge of dangers, orientations towards acting with these, collective power to resist danger and work performance are raised, albeit in distinct forms. Employers try to ensure performance through resorting to diverse strategies which include offering of incentives, use of power and control over the production and distribution of knowledge. Workers respond favourably to some strategies and, at the same time, may develop their own strategies in an attempt to control the job. When action aiming to increase industrial safety is engaged in by management it can be referred to as employer safety management, when exercised by workers as auto-control. Depending on the level at which it is exercised it can also be called auto-organisation, auto-command or auto-organisation and employer safety management obeys the same system.

At the rewards level work is produced through the manipulation of payments, whether monetary or symbolic, in return for work effort, whether through an

intensification of work (eg. through piece payments) or through its extension (eg. the offering of overtime).

At the command level work is produced through the use of power. This may be overt and resisted (eg. authoritarianism) or covert and accepted (eg. in cases where risks are accepted as a normal part of work). This level's functioning to the benefit of employers is only guaranteed by the absence of collective action capable or opposing the employer's use of power, the basis of this guarantee is the absence of work group integration.

At the organisational level work is produced through employer control over the division of labour. This translates into task structure, relationships between tasks, task demands, the knowledge the workers have of these and their capacity to react independent of the influence of social relations at other levels.

The individual-member level is made up of that part of the worker that is not organised, commanded, rewarded. It is made up of the autonomy that remains to the workers after the working through of the social relations to which they are submitted.

Industrial accidents literature interpreted sociologically

The rewards level is seen in the literature as producing accidents through financial incentives, long working hours, symbolic rewards, incapacity of poorly nourished workers to perform tasks in safety. No one of these factors "existing" by itself necessarily causes accidents, and effects may be differentiated by sector or factory. One Canadian study showed, for example, no link between financial incentives and accidents (Mason, 1977)- a result that appears in sharp contradiction with that produced in a Swedish mines and logging, where reductions in accident rates ranging from 30% to 95% were isolated subsequent to the abolition of financial incentives (Ekstrom, 1981. Hazards Bulletin, 1977). This difference is more apparent than real since, for incentives to be effective, people must be oriented to work harder to earn them, for them to produce more industrial accidents greater risks must be taken to earn them. The incentive need not be financial, it can be symbolic (Haas, 1977. Freilich, 1970). At this same level exists the relation of extended work, people work longer than is sare or work beyond their physical capacities and, as a result, have an accident. However, job demands differ between sectors and workers have different capacities. One illustration is provided by Scline (1976), he calculated that an increase in the working day by one hour results in a 30% rise in accidents in the metalworking sector whereas in the construction and clothing sectors he discovered no link. A predominantly muslim group of construction workers in France were found, during the period of the Ramadan fast, to experience a rise of about 40% in their accident rates (Grand and Laurent, 1969). Clearly, a management strategy to change work scheduling during Ramadan to take account of such reduced capacities would have a role to play in reducing accidents. During World War I research showed, to cite a spectacular example, that an increase in the work week from 60 to 72 hours was associated with a two and a half times increase in accidents (Vernon, 1918). Other research results link reductions in working hours to declines in accident rates.

The command level is not seen in the safety literature as having an important weight in accident production. What can be referred to as workgroup disintegration has been seen in a German study to be responsible for 10% of accidents in three steelworks (Neuloh et al, 1957) and 5% of fatal construction accidents in a Parisian sample (Wisniewski, 1977). Clearly greater workgroup integration, whether sponsored by employers or workers, could be expected to result in a reduction of the associated accidents. The acceptance of danger as a natural part of the task is seen in some management oriented literature as a problem to be overcome, and has been identified as a factor in the production of accidents by sociologists (Hopkins, 1984. Edwards and Scullion, 1982). In the absence of workgroup integration, frequently formalised as union power, the employer resort to authoritarianism can be facilitated. The ineffectiveness of union results in accidents on the British North Sea Oil fields in Carson's (1982) judgement. Subsequent to the dismissal of an automobile factory's shop stewards Turner et al (1967) reported an increase in accidents. In British coal mines Hill and Trist (1955) tentatively attributed the reduction or accidents on night shift to there being less "authority" on this shift or, in the terms developed here, to a rise in employee auto-command.

Social relations at the organisational level produce the majority of work accidents in advanced industrial nations. The monotony and boredom associated with routine work has been seen as responsible for accident production (Caillard, 1976. Raymond, 1952). Job rotation and enlargement are strategies adopted, formally or informally, to reduce the weight of routine. Increasingly disorganisation appears built into the more complex industrial and work processes, it can be seen as at the origin of the Three Mile Island (Perrow, 1984) and the Challenger accidents (Rogers, 1986). The traditional notion of "good housekeeping" expresses an idea of the absence of one form of disorganisation and that of "routine maintenance" embodies an employer strategy to avoid the delays and dangers that issue from another. Disorganisation may produce demands on workers to perform corrective tasks for which they are inadequately trained. Non-usual tasks occupying 5% of worktime were found by Trautes (1967) to be responsible for 60% of accidents. In a different vein underqualification's role in ordinary work settings has been examined: accident victims were found to have considerably less experience than non-victims working at matched tasks (Powell et al, 1971). A Swedish study produced a similar result (Hagbergh-Olycksfall, 1960). Ellis's literature review reported little solid research to support the claim that training reduces accidents. As an employer organisational level safety management strategy training has been frequently attributed an important role in accident prevention (Quinot and Moyen, 1980) Consistent with this North American studies report reductions in accidents by 50% in the chemicals and pulp and paper industries (Collisson, 1984. US Bureau of Labour Statistics, 1971).

The individual-member level through accident proneness, individual carelessness, differentiated individual cognitive capacities and other such factors

production. From the point of view of a sociological theorisation it is highly unlikely that this be singly responsible for a significant proportion of accidents.

HYPOTHESIS FORMULATION

The presentation up until now leads to the formulation of certain hypotheses. First the management of a level through certain social relations will be associated with the production of accidents at that level. This is the key hypothesis that underlies the sociological approach. Hypotheses to be tested in this article are derivable from the previous discussion. A reduction in the domination of a given level will be associated with a reduction in accidents at that level. An increase in the weight of a level will be associated with a rise in accidents at that level.

The resort to strategies, whether employer or employee promoted, that reduce the weight of social relations at whatever levels will be associated with reduced accident production at those levels.

These hypotheses are general and it has already been noted that relatively complex interactions exist between levels. It is possible, through appropriate research, to define individual accidents as being produced by social relations at whatever level.

We can derive two hypotheses for testing. These will be tested against hypotheses drawn from other perspectives to see if they have utility for explaining observed drops in accident rates but, before discussing the rather complex hypotheses in detail, let us examine questions of study design and method.

SECTION 2
METHOD AND DESIGN

The research is based on a case study approach and the use of mixed methods- semi-participant observation of the workplace which includes semi-structured interviews with staff and the analysis of company records. Such an approach to the study of work is a classical one for the social sciences and, for the study of accidents, a rare one (Faverge, 1967. We Plat, 1978). Data gathered by one method is checked against that gathered by another to ensure the production of valid explanations (Denzin, 1970).

From the point of view of design it is best that a study be tightly controlled, since this permits the testing of various competing explanations free from the influence of uncontrolled factors. It is however notoriously difficult to control social science field studies.

In function of the, above design consideration research took place in shiftwork seven factories. Shiftwork was chosen because it constitutes a semi-experimental form of work in which, when it involves rotating schedules, workers, machines and materials stay the same between shifts. Given this control any observed changes in accident rates have, necessarily, to be explained in terms of factors that exclude reference to the items controlled for. In fixed shift schedules machines and materials are controlled for. The literature on shift work reveals contradictory results and no intrinsic link between night and day shifts and accidents (Smith, 1979). Five of the plants

chosen were subject to rotating shifts two to fixed shifts.

These plants were also chosen to be representative of certain technological types and management styles. Technologically the dominant production system run from (a) semi-artisanal, through (b) semi-mechanised, to (c) continuous process production (Touraine, 1962). "Management styles" were of three types: (1) Compacted management, in which employers did not resort to the use of the rewards level to intensify work and workers exhibited strong collective organisation at the command level, (2) Traditional management, in which employers managed via incentive systems at the rewards level and workers were not collectively organised at the command level, (3) Induced management, in which employers managed via incentives at the rewards level and workers were strongly organised at the command level.

Table 1 locates the plants and their variations in accident rates. [insert Table 1]

TABLE 1
Technological Type

	SEMI-ARTISANAL	SEMI-MECHANISED	CONTINUOUS PROCESS
compacted management	PLANT A day= night=	PLANT C day= night=	PLANT B day= night=
traditional management	PLANT D day= night=	PLANT E day= night=	
induced management		PLANT F day= night= PLANT G day= night=	

Con 2B.

7.

STATISTICALLY TESTING FOR EXPLANATORY POWER:
CONVENTIONAL AND SOCIOLOGICAL EXPLANATIONS EXAMINED.

STATISTICALLY TESTING FOR EXPLANATORY POWER:
CONVENTIONAL AND SOCIOLOGICAL EXPLANATIONS EXAMINED.

A coorelation matrix, consisting of each possible pair of the 35 variables listed was built. [see table 2]

[insert table 2 ADRIAN -note variable 18 has been excluded and in plant b on night.shift v32 = 1]

The examination of relationships between factors such as frequency of government inspections, presence of safety devices, effects of different spans of control can be examined. Some of the variables developed merit detailed explanation.

[ADRIAN- put the variable descriptions where, here or in an appendix?]

Certain have been built especially for the testing of the two sociological hypotheses relating to accident prevention. They reflect the notion expressed in the theory that that complex articulations exist between the various levels of social relations.

Evidence accumulated from the case studies indicates a confirmation of the hypothesis relating to auto-control of all levels by workers. The key factor associated with declines in accident rates appears to be auto-command, where it exists accident rates are reduced because it articulates into the reduction of the weight of other levels of social relations. Empirically, auto-control has been found to be exercised via auto-command which articulates into other levels in those situations where the weight of employer power at the command level is reduced. Plant F day workers exercise auto-rewards, and do so without exercising auto- command and this is associated with a reduction in their accident rates- these different situations are aggregated under an especially developed variable: auto-control. A simple rise in auto-control does not, a priori, lower accidents, it is theoretically possible that it be associated with a countervailing increase in the weight of certain social relations.

The hypothesis can be partially translated in the following form: in a given plant if the weight of the command level decreases, the best predictor of what will happen at all other levels (other than the individual-member level) is auto-control (v27), if this is high (ie. the variable has a value of one) and is associated with an overall decrease in the weight of the rewards (v31) and the organisational levels (v29), a decrease in accident rates will be produced. A variable B11 has been built to allow this hypothesis to be tested.

In these case studies what can be sociologically defined as employer safety management is indistinguishable from employer command level control

8.

(thus v30 serves to measure it when its value is equal to two). When this is high, it can be hypothesised, domination at either the organisational and/or the rewards levels will lessen and this will produce a decline in accident rates. Looking at Table 2 the evidence does not point to a confirmation of this hypothesis in plants other than F, D and E. This could lead to a preliminary interpretation that safety management, in its sociological sense, does not have any general effect on the reduction of accident rates. However, such a judgement is precipitated.

Empirically the studies revealed a complex link between the absence of employer command level safety management and the absence of auto-control. In the cases where these two coincide a rise in accidents was observed, this observation allows the hypothesis relating to employer safety management to be reexamined. In a simple form: where workers are unwilling or unable to exercise auto-control, it can be hypothesised that managerial safety management at the command level plays an effective role in accident reduction.

In a given plant, if employer control at the command level (v30) decreases, the best predictor of what will happen at all other levels (except the individual-member level) is auto-control (v27), if this is low (ie. has a value of two) then the weight of either the rewards (v31) and/or organisational levels (v29) increases. If the overall weight of both levels rises (and does so to a greater extent than the decline produced in the weight of the command level), the accident rate rises. A variable, B12, has been generated to allow this hypothesis to be tested.

In calculating the coorelations between the independent variables several groups of variables were shown to be perfectly coorelated with each other. This implies that data cannot distinguish between their effects on accident rates. These are v1 and v36, v13, v21, and v26, v29 and v31.

The most important result (for subsequent modeling) that this revealed is that the 4 variables (v2, v15, v16, v17) are very highly coorelated with one another. The latter three are diverse subjective measures of the physical dangers of the workplace, these also coorelate with process type (v2). This latter coorelation could be a simple reflection of the nature of the restricted universe of factories using nightwork in New Zealand, where process type A firms with low accident rates and process type C firms with high accident rates may not resort to nightwork, or to sampling difficulties. Five further variables (v5, v6, v13, v14, v20) are also highly coorelated with one another, these capture a chance coorelation of the frequency of government inspections with a series of what appear to be cause-effect relations between managerial control style, incentives, and labour turnover.

MODELING THE DATA

A simple probability model, requiring only form parameters is fitted to the entire set of accident data.

[ADRIAN, I shall eliminate all the stuff in the old paper, and let you tell about the modeling] — from your MODELING Acc. Rates

The modeling process is summarised in table 3.

[insert Table 3]

TABLE 3

MODEL.	DEVIANCE	DEGREES OF FREEDOM	% of DEVIANCE EXPLAINED (R^2)
1. All plants same	38.45	13	0
2. v16	22.56	12	41
3. v16 + BT2	11.33	11	70
4. v16 + BT2 + BT1	5.62	10	85
5. v16 + BT2 + v8	5.52	10	86

Models 4 and 5 are the preferred models, the data do not allow one to be preferred over the other. From a theoretical point of view Model 4 is more consistent with the hypotheses, and for this reason we will treat it in some detail. This preference of models is obtained by an overall X2 goodness-of-fit test based on the deviance, and by an analysis of residuals. The model predictions are contained in Table 4, in this table none of the differences between actual and predicted data are significant.

[insert Table 4].

TABLE 4

PLANT	ACTUAL NO. OF ACCIDENTS	NO. PREDICTED BY MODEL 4	MODEL 5
A day	21	21	19
A night	14	11	12
B day	10	10	10
B night	6	5	6
C day	10	11	11
C night	4	5	7
D day	3	2	2
D night	4	4	3
E day	2	4	5
E night	3	6	5
F day	9	8	9
F night	14	12	13
G day	19	17	15
G night	6	8	7

Concretely Model 4 means:

(i) that increasing v16 by 1 increases p (the probability of an accident) by a factor of $e^{0.21} = 1.23$, ie. by about 23%

(ii) increasing BT1 by 1 (ie. going from a situation where BT1= 0 to one where BT= 1) reduces p by a factor of $e^{-0.51} = 0.60$, ie. by about 40%

(iii) increasing BT2 by 1 increases p by a factor of $e^{0.51} = 2.11$, ie it more than doubles p.

In a plant subject to a given level of risk effective accident prevention is produced by workers who exercise auto-control at all levels and by management which, in the absence of a worker orientations favourable to auto-control, engages in safety management as defined sociologically.

THE CASE STUDIES: a qualitative treatment

Between plants run under the same management style or using technologies of similar levels considerable variations can be found. Some of these are quantified in table 2 and these and others have been explained in more detail elsewhere (Dwyer, 1981). Here a brief overview of similarities and differences will be given.

In none of the plants researched was the command level responsible for the production of the majority of accidents. Authoritarianism played an important role in the traditional management style. In the unionised plants it was used occasionally, and notably in breakdown situations in plants without incentive systems where it forced a prompt return of production. Management power functioned, almost universally, to reduce worker autonomy to act in function of orientations developed in reaction to the rewards and organisation levels. In some plants, particularly those subject to traditional management, dangers had come to be accepted as normal, this directly produced diverse accidents such as cuts and burns. Workgroup disintegration, although seen as a potential source of danger in all except plant F, did not directly produce accidents in all.

In plants A, B and C. in spite of the different technologies used, the drop in accident rates observed at night was universally explained as being a result of the reduction in employer command pressure. From a sociological viewpoint such a reduction does not necessarily lead to a decline in accidents, it must be accompanied by appropriate changes in social relations. In these plants workers were both "safety conscious" and well organised in defense of their interests. At night, they resort to auto-command, this resulted in an increase in their refusal to work in situations defined as dangerous and a decline in employer resort to authoritarianism. More importantly it articulated into other levels.

At the rewards level extended work represented a potential problem in all plants. However, different employer policies resulted in differentiated potential effects of this relation. In the three plants with a compacted management style, union pressures had lead to managerial decisions to replace absent workers by placing other workers on a double shift. In the plants subject to traditional management the absence of strong unions permitted short staffing to be used to bridge those gaps produced by absentees. In the remaining plants employers were able to resort to strategies unavailable elsewhere, they reacted to union demands for adequate staffing mainly by shutting down individual machines. A priori, extended work would appear to be have the greatest importance in plants subject to compacted management.

On night shift workers in plants A, B and C, taking advantage of the reduction in employer command power resorted to auto-rewards: overly tired workers being spelled informally by colleagues, such a practice being prohibited by management on day shift.

Financial incentive systems were used in four plants. In rotating shift plants D and E workers were highly motivated by the incentives and inter-shift competitions, to reduce the negative effects of their actions employers resorted to command level safety management on day shift.

In these two plants under less night-time employer command pressure workers could be seen and acknowledged taking, different to their counterparts subject to

compacted management, greater risks to increase production levels. Workers' natural tiredness on night shifts coupled with the inexistence of any system, formal or informal, to spell overly tired workers also contributed to increase risk on this shift.

Plants F and G, subjected to the same management style, show contradictory patterns of accidents between shifts. This is intimately linked to characteristics of fixed shifts- differentiated staff displays different orientations and capacities when confronted with similiar changes in managerial control of social relations.

Plant F exhibits a pattern that fits into the conventions already discussed. In spite of a generally high level of safety consciousness, night shift workers, in the absence of employer command power, and in function of their orientations to earn financial incentives, take risks. Day shift workers are on average older and, having already achieved a certain degree of financial security, consistent with Lindstrom and Sandstrom-Fisks' results (1976), were- independently of the increased managerial control on this shift- less favourably oriented to earn them than their younger night colleagues. Other rewards level relations were not seen to vary between shifts.

Plant G day workers took, in spite of greater managerial command level presence, greater risks because more favourably oriented towards the bonus system than their night counterparts. Task requirements were such that experience and ability, rather than effort, were the important ingrédients in bonus earning, recognising this the more experienced day workers displayed a more favourable orientation to bonus earning than their night colleagues. A relatively strong sense of safety values was present on both shifts, and these articulated into auto-rewards and safer work performance only at night.

Underqualification presented itself in various forms and in varying degrees. Where high labour turnover coexisted with demands that a worker perform a large number or complex set of tasks its was most common. Formal training programmes were linked by interviewees to reductions in the relation's potential in some plants. Disorganisation because of breakdowns proved to be particularly chronic in plant C on day shift, minimal in plants E and F and varied between these extremes in the other plants. Neither plants with a semi-artisanal process type, nor plant E -where the large variety of products made and the high labour turnover rate reduced its possible action- was routine common to principle production tasks. Elsewhere its weight in accident production varied, never reaching that of other organisational level relations. The organisational level dominated the production of accidents in all plants researched.

On night shift underqualification increased thus raising the weight of the organisational level in plants C and E. Absenteeism was higher on night shifts. Replacements, in the absence of active unions, moved workers up the job hierarchy to cover for absentees, consequently inadequately qualified people were placed in jobs. Absenteeism was more common on the night shift, for this reason the weight of underqualification on this shift increased.

In plants A, B and C auto-organisation, through strategies such as the rotation of routine tasks and the correction of disorganisation, took place. The weight of organisational level relations declined in function of this although in plant B the decline was less pronounced than elsewhere.

On night shift in plant F the organisational level's weight increased since workers repaired their own machines to counter inadequate maintenance thus producing underqualification. It was thought that task monotony combined with night work produced a specific type of routine work and accidents, but this notion was unable to be validated.

In plant G routine appeared to increase on days because the workers are more accustomed to their tasks than their less senior night time counterparts. In addition, the company promotion structure placed the longer serving workers in the most skilled and heaviest job. An articulation between the organisational and individual-member levels was thus produced which resulted in numerous back injuries to the most skilled day shift workers, their younger night time counterparts suffered less such injuries.

The individual-member level only demonstrated importance for accident production in plant G where, as we have just seen, linked to the organisational level decision to allocate older workers to the most senior and heavy job, it provoked a large number of back injuries. In other plants its importance was generally seen to rise slightly on night shift however, the rise was insufficient to produce observable effects on accident production.

The studies, here reported in a simplified form, have highlighted the complexity of the causal interrelations between the levels. The notion underlying the sociological theory of industrial accidents, that accidents are to be seen as products of social relations and to be prevented by changing these relations, was validated in these case studies. Specific changes in accident rates were explained by specific transformations in social relations. Competing non-sociological notions of cause and prevention were tested for statistically and seen not to exhibit explanatory utility.

Such results should provide as a strong stimulus to further research and development not only in sociology but in all disciplines that aim to prevent accidents.

IMPLICATIONS FOR ERGONOMICS

Rinefort (1977) suggested, in one of the pioneering studies of safety expenditure using the tools of cost-benefit analysis, that "the most effective mix ... would seem to be a balanced approach which combines both engineering and non- engineering and probably puts more emphasis upon the non- engineering aspects." One non-engineering approach that has shown its utility is a sociological approach. For the disciplines that seek to promote industrial safety this implies that all worker-equipment interactions be seen as mediated by social relations at the rewards, command and organisational levels.

Without increasing costs to competitive sector firms certain changes in social relations have been shown to

reduce accidents. Two practical consequences, one methodological the other theoretical can be drawn. Ergonomics should focus greater intention on workplace investigation. This idea is, of course, not new having been advocated by the Belgian ergonomist Faverge (1967) over twenty years ago. What is new is the theoretical support now provided for this form of investigation.

Henceforth ergonomists will be able to analyse accidents as being produced by social relations. A practical consequence of such an analysis is that modifications to plant, equipment and processes will be suggested only when their interaction with the work relations is understood. Furthermore, the investigation of the appropriateness of proposed technologies for existing or hypothesised patterns of social relations will become a basic consideration in each ergonomic intervention. The adoption of this new dimension to the discipline's analysis will enable the ergonomist's intervention to acquire a new efficiency.

Sept. 10, 1987

MODELING ACCIDENT RATES

by Adrian Raftery for Tom Dwyer

CONTENTS

1. SUMMARY

A simple probability model, requiring only four parameters, is fitted to the entire set of accident data. Accidents rates are predicted by

(i) a measure of the physical danger of the work (v16 is chosen but it could, almost equally well, be one of v15, v17, or v2).

(ii) Whether or not v27=2, v30=1, v31=2 [Tom's theory (b)].

(iii) either
   (a) no. of workers per foreman or manager (v8); or
   (b) whether or not v27=1, v30=1, v31=1 [Tom's theory (a)].

The data cannot distinguish between (a) and (b), although these are not equivalent.

Thus, Tom's theory is strongly supported by the data, although whether both parts are necessary, or just part (b), is not clear.

2. METHODS

2.1. The probability model

Suppose the probability of an accident in a shift at plant is (here $i=1,\ldots,14$: day and night shifts are counted separately) is p_i. Suppose the conditions there are specified by independent variables $x_{i1},\ldots,x_{im}$. Then our model is the logistic regression model of Cox (1970), namely

$$\log\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \sum_{j=1}^{m} \beta_j x_{ij} \qquad (2.1.1)$$

where $\beta_0, \beta_1, \ldots, \beta_m$ are unknown parameters which have to be estimated from the data. This can be done best by the maximum likelihood method, which is implemented in the computer program GLIM (Baker and Nelder, 1978); see also McCullagh and Nelder (1983). This also yields tests, through the sampling distribution of the deviance of the fitted model.

All that has to be done is to choose the x's in (2.1.1) from the wide choice available here. This is done here in a step-wise manner. We start with the 32 variables V1, ..., V32,

⊛ log means log to the base e, a natural logarithm.

plus 2 others, BT1 and BT2, which represent Toni's theory and are explained in the next section. We end up with 3 variables.

We base all inferences on the fitted probability model. An important point is that tests based on individual variables taken one at time, such as those you asked for on p.13 of your "manual", can be misleading, for the following reason. The most significant variables are those which measure physical danger (V15, V16, V17, and V2). Many other variables appear significant when considered in isolation, but it turns out that this is an artifact in many cases. These variables appear to influence accident rates, but in fact they are correlated with physical danger — once one controls for physical danger their effect disappears.

2.2. Toni's model

The main aim of this exercise is to test Toni's model, which was summarized on p.12 of the "manual":

(i) if V30=1, V27=1, and V29 or V31=1, we expect accident rates to drop.

(ii) if v30=1, v27=2, and v29 or v31=2, we expect accident rates to rise.

To represent this hypothesis we introduce two new variables, BT1 and BT2 (BT is for "Big Test"). BT1 corresponds to (i) and is defined by

$$BT1 = \begin{cases} 1 & \text{if } v30=1, v27=1, v29=1 \\ 0 & \text{if not} \end{cases}$$

BT1 is equal to 1 for the plants A night, B night, C night, and G night, and is equal to 0 for all other plants.

BT2 corresponds to (ii) and is defined by

$$BT2 = \begin{cases} 1 & \text{if } v30=1, v27=2, v29=2 \\ 0 & \text{if not} \end{cases}$$

BT2 is equal to 1 for the plants D night, E night, and F night, and to 0 for all other plants.

2-3. The data

Calculating the correlations between the independent variables showed that several groups of variables are perfectly correlated with each other. This implies that the data cannot distinguish between their effects on accident rates. They are:

- v1 and v30
- v13, v21, and v26
- v29 and v31.

3. DATA ANALYSIS AND MODEL FITTING

3-1. Preliminary data analysis: the correlation matrix

I calculated the correlation matrix, consisting of the correlation for each possible pair of the 36 variables AA+AB, AB, E, F, V1, ..., V32. The most important thing (for subsequent modeling) that this revealed is that the 4 variables {v2, v15, v16, v17} are very highly correlated with one another. v15, v16 and v17 are clearly measures of the physical danger of the work, and this appears also to correlate with v2, process type. In terms of a model, these 4 variables are, statistically, effectively proxies for one another, and can be used almost interchangeably.

The second thing which stands out is that the 5 variables {v5, v6, v13, v14, v20} are also highly correlated with each other. Since these are turnover, incentives, control style, and frequency of inspection, they are capturing something like "type of management". Statistically, in terms of predicting accident rates, they would be effectively proxies for each other. However, they do not appear in the final model, so this is not so important.

3.2. Fuit stage of modeling

This consists of selecting the fuist independent variable to be included in the model. It is done by including each vanable are at a time, and choosing the are which redues the deviane the most (deviane is a generalization of residual sum of squeas).

v16 is the vanable which fits best, reducing deviane by 41% (a sort of R^2) for are degree of freedom. It is closely followed by v2, v15, and v17, which is not surprising, given the discussion in section 3-1.

14 variables were not significant at all, even considered in isolation, and so can be eliminated from the analysis at this stage. They were: v1, v4, v5, v6, v11, v12, v18, v19, v20, v23, v24, v25, v28, v32.

16 variables were significant, when considered in isolation, namely v2, v3, v7, v8, v9, v10, v13, v14, v15, v16, v17, v22, v27, v29, BT1, BT2. Most of thee are artificacts fa the reasas pointed aut in section 2.1, as we shall see in section 3.3. [Note that the 4 vanables v21, v26, v30, v31 are not considered separately hee, for the reasas pointed aut in section 2.3].

3.3. Second stage of modeling

This consists of choosing the next vanable to be included in the model. It is done by including each of the independent variables, not excluded at the fuist stage, are at a time, along with v16. Again, the are which redues deviane the most, fam that left unexplained by v16 alare, is chosen.

BT2 is the vanable which fits best, followed closely by BT1. BT2 redues the deviane by half, to about 30% of its aiginal value.

9 variables were not significant at this stage, indicating that their apparent significanca at the fuist stage was illusory, due to their association with v16. They were v2, v3, v9, v10, v13, v14, v15, v17. Note that v2, v15, v17 are all in this list, indicating that v16 is a good proxy fa the entire group of vanables {v2, v15, v16, v17} - the "physical danger" vanables. Also, v3 is in that list, indicating that, after controlling fa physical danger, thee is no significant differane in accident rates between rotating and non-rotating shifts.

6 vanables were significant at this stage: v7, v8, v27, v29, BT1, BT2. Note that, again, this is only apparent, and several of these significant results turn aut to be spurious after controlling for BT2.

3.4. Final stage of modeling

We now have 2 variables in our model: v16 and BT2, and 5 other variables which we have not discarded: v7, v8, v27, v29, BT1. We try adding these into the model, one at a time, as before. The most significant are v8 and BT2 (almost equally). v29 is also significant (actually a spurious effect!), while v7 and v27 are not. Adding in a fourth variable does not reduce deviance appreciably, and it is impossible to remove any variable from either of the selected models without increasing the deviance significantly.

The entire modeling process can be summarized in the following table:

Table 3

Model:	Deviance:	Degrees of freedom	% of deviance explained ($\approx$ "R^2")
1. All plants same	38.45	13	0
2. v16	22.56	12	41
3. v16 + BT2	11.39	11	70
4. v16 + BT2 + BT1	5.62	10	85
5. v16 + BT2 + v8	5.52	10	86

Thus models 4 and 5 are our preferred models; the data do not allow us to prefer one over the other. Model 5 fits the data a minuscule amount better, while model 4 seems more "theory-consistent". Both models fit well, both by the overall χ^2-goodness-of-fit test based on the deviance, and by an analysis of residuals. Here are the model predictions, which show just how good they are:

Plants:	Actual no. of accidents	No. predicted by model 4	No. predicted by model 5
A day	21	21	19
A night	14	11	12
B day	10	10	10
B night	6	5	6
C day	10	11	11
C night	4	5	7
D day	3	2	2
D night	4	4	3
E day	2	4	5
E night	3	6	5
F day	9	8	9
F night	14	12	13
G day	19	17	15
G night	6	8	7

None of the differences between actual and predicted are significant.

4. FINAL MODELS: PARAMETERS AND INTERPRETATION

Model 4 is

$$\log\left(\frac{p}{1-p}\right) = -8.34 + 0.21(v16) - 0.51(BT1) + 0.75(BT2)$$
[se] [0.042] [0.12] [0.25]

All the parameters are highly significantly different from zero. The model means that

(i) increasing v16 by 1 increases p (the probability of an accident) by a factor of $e^{0.21} = 1.23$, i.e. by about 23%.

(ii) increasing BT1 by 1 (i.e. going from a situation where BT1 = 0 to one where BT1 = 1) reduces p by a factor of $e^{-0.51} = 0.60$, i.e. by about 40%.

(iii) increasing BT2 by 1 increases p by a factor of $e^{0.75} = 2.11$, i.e. it more than doubles p.

All these results are strikingly in agreement with your theory.

Model 5 is

$$\log\left(\frac{p}{1-p}\right) = -7.92 + 0.17\,v16 + 0.97\,BT2 - 0.038\,V8$$
[se] [0.043] [0.25] [0.017]

Again all the parameters are significant, and the parameters for v16 and BT2 do not differ significantly from their values in model 4. The model means that

(i) increasing v16 by 1 increases p by $e^{0.17} = 1.19$, i.e. by about 19%.

(ii) increasing BT2 by 1 increases p by $e^{0.97} = 2.64$, i.e. by well over a factor of 2.

(iii) increasing the no. of workers per foreman or manager by one reduces p by a factor of about $e^{-0.038} = 0.96$, i.e. by about 4%.

[Tom: Is (iii) theoretically OK? If not, it would be a good reason to go with model 4, since the coeff of v8 is not highly significant.

5. OTHER POINTS

(1) Variables E and F: I was uncomfortable about modeling these. F depends crucially on the age structure of the work force, and would require a much finer demographic analysis before defensible conclusions could be reached. E also depends on the age structure, I assume: plants F and G give some hint of that.

(2) Design effects: Here the whole analysis is conditional on the independent variables, and inference is made as if these were fixed by design. So this does not seem to be a problem.

(3) Bias towards big plants: The model produces inference based on all the available data in the statistically most efficient way possible. Also, the table on p. 10 (actual vs. predicted nos. of

accidents) shows that prediction errors are generally very small and are of about the same size for all types of plant. So this is not a problem.

(4) Rotating shifts plants only: See section 3.3 (non-significance of V3).

(5) Differences between plants: I did fit a model with a separate parameter for each plant. However, this did not significantly reduce deviance. The conclusion is that, insofar as accident rates are concerned, differences between plants are fully accounted for by V16, BT2, and BT2 a V8.

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Industrial Accidents are Produced by Social Relations of Work: A Sociological Theory of Industrial Accidents

Tom Dwyer

Universidade Estadual de Campinas

Adrian E. Raftery

University of Washington

ABSTRACT

Industrial accidents are produced by social relations of work. This sociological explanation of accidents differs from the hypotheses on which the majority of modern safety practices are based, which reduce accident causes to unsafe acts and unsafe conditions. Accidents are seen as produced at each of three levels of social relations of work (rewards, command and organisation), and also non-socially at the individual-member level.

The resulting hypotheses were tested using data collected according to a semi-experimental design in seven plants in which shift (day/night), shift type (rotating/fixed), technological type and management styles were the factors controlled for. Because of the design, machines, materials, and, in most cases, workers, were the same across shifts and social relations varied. The sociological theory proved capable of explaining most of the variation in inter-shift differences in accident rates, and, when tested statistically, appeared to have greater explanatory power than competing hypotheses.

We conclude that accidents can be prevented by workers who exercise auto-control at all levels and by management which, in the absence of worker orientations favourable to auto-control, engages in safety management as defined sociologically. A practical consequence for ergonomics is that when plant, equipment and processes are to be modified an attempt to understand their interaction with the social relations of work should be made. A theoretical consequence is that sociological insights should be incorporated into the perspectives of the ergonomics discipline.

Tom Dwyer is Professor Assistente-Doutor, IFCH-DCS, Universidade Estadual de Campinas (UNICAMP), Caixa Postal 6110, 13081 Campinas SP, Brasil. Adrian E. Raftery is Professor of Statistics and of Sociology, Mail Stop GN-22, University of Washington, Seattle, WA 98195, USA. The article was completed while Dwyer was a Visiting Fellow at the Science Technology and Society Program at Cornell University on a Brazilian Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (CNPq) post-doctoral research grant. Raftery's research was supported in part by the National Science Foundation under Grant no. SES-8615541. Earlier versions of this paper benefited from discussion arising from presentations to a seminar in the

INTRODUCTION

It should be of no surprise that ergonomics, along with nearly all other "modern" academic disciplines, is being hit by the "crisis of modernity" (Touraine, 1988) and, because of this, it is transforming itself. The ideas that theoretical advances are necessary in the treatment of industrial accidents and that existing systems of analysis are in crisis are two sides of the same coin. The prevalence of these notions is illustrated in safety engineering (Kletz, 1980), psychology (Wigglesworth, 1978; Sass and Crook, 1981), industrial medecine (Berlinguer, 1983) and government intervention (Smith, 1979), to take just four areas.

Demands for the setting of government standards and cost-benefit analysis provide new challenges, the former in terms of the performance of ergonomics and the latter in terms of its ethical position vis-a-vis those whom its action directly affects — workers. Certain leading theorists in ergonomics have been receptive to the idea that major theoretical advances are needed: in both Britain and France it is suggested that a "crossroads" has been reached (Davis, 1983; de Keyser, 1984), and Singleton (1982) goes so far as to see the necessity for "radical new thinking."

This "radical new thinking" is exhibited with respect to accidents in two special issues of the French journal "Le Travail Humain" (Cuny, 1986). The perspectives and approaches suggested there include psychopathology, epidemiology, training, and the use of computer resources for investigation and analysis of accidents. Leplat (1985) seeks to understand error at work by laying a psychological basis for its ergonomic analysis, while Rasmussen, Duncan and Leplat (1987), in a multi-disciplinary book on new technology and human error, bring together perspectives from engineering, cognitive psychology and hermeneutics.

Laboratoire d'Ergonomie et Neurophysiologie du Travail at the CNAM, Paris in November 1989, and to the August 1990 American Sociological Association Conference in Washington D.C. The authors are extremely grateful to Ed Gross, Jim McCann, the Editor-in-Chief (E.N. Corlett) and two anonymous referees for comments which had an important role in improving the paper.

Sociology and ergonomics have traditionally ignored each other. It should therefore come as little surprise that the most reconceptualisation attempts by ergonomists exclude specific references to a sociological tradition. Certain university ergonomics courses and the work of some researchers are exceptions to this. Thus, localised attempts to formulate new thinking along lines compatible with a sociological approach can be found. For example, Wisner (1981, 1985), because of his research on technology transfer, moved outside traditional French ergonomics perspectives to advocate a new area of multi-disciplinary study called anthropo-technology. Perrow's (1983, 1984) sociological analysis of failures in high technology systems leads him to suggest that human factors engineering turn its attention to a range of factors, especially social ones, that influence work performance. Such efforts appear as forebears of what may, one day, become an important component of the renewal of ergonomics as a discipline — its cross-fertilisation with a sociological perspective.

Here, we bring briefly together some elements of a sociology of work, and describe a method with which to test the theory, and a semi-experimental study design. Brief qualitative accounts of the plants researched are given. The data obtained is then modelled statistically, and a hypothesis derived from the sociological theory is found to have greater explanatory utility than other conventional ones, explaining much of the variation in inter-shift differences in accident rates. Some implications of this analysis for ergonomics are drawn in a conclusion.

A sociological theory of industrial accidents

Industrial accidents are produced by social relations of work. This hypothesis underlies our sociological reflection on the production of accidents. It is radically different to the hypotheses on which the majority of modern safety practices remain based, ones which reduce accident causes to unsafe acts and unsafe conditions. A sociological theory of accidents has two "moments". In the first the workplace can be seen as made up of a series of "givens" — materials, machines, processes, product markets, a labour force and so on — that are formed

by the working through of social relations external to the workplace. These can be changed by altering the relations that produce them, or by introducing different sets of "givens" into the workplace. In a second moment, within the workplace, these "givens" are assembled and managed in a process that produces goods, services and industrial accidents. It is this second moment that we shall discuss.

In this theory three levels of social relations of work, rewards, command and organisation, are conceptualised. A social relation is the mannner in which the relationship between people and their work is managed. In addition to being produced at these three levels, accidents are produced non-socially at what we shall call the individual-member level. By using the word "levels", we do not imply that these are hierarchical with one level having, a priori, superiority over the others. Rather, the term refers to a conceptual distinction between functionally distinct systems of social relations.

The levels, although distinct from an analytical viewpoint, are interrelated: a change in one might alter the way another operates, such an alteration having effects on production, absenteeism, accidents and so on. At each level, questions are raised about knowledge of dangers, orientations towards acting with these, and the collective power to resist danger and the performance of dangerous work. Employers try to ensure performance by offering incentives, by using power, by controlling the production and distribution of knowledge, and by other means. Workers respond favourably to some such strategies and, at the same time, may develop their own strategies in an attempt to control the job. In the sociological theory, when action aimed at increasing industrial safety is engaged in by management, it is called managerial safety management. When exercised by workers, it is called auto-control. Depending on the level at which it is exercised, auto-control can also be called auto-rewards, auto-command or auto-organisation, and managerial safety management can, likewise, be linked to the levels at which it is practiced.

At the rewards level, work is produced through the manipulation of recompense, whether monetary or symbolic, in return for work effort, whether through an intensification of work,

e.g. piece payments, or through its extension, e.g. overtime.

At the command level work is produced through the use of power. This may be overt and resisted, e.g. authoritarianism, or covert and accepted, such as when risks are accepted as a normal part of work. The functioning of this level to the benefit of employers is guaranteed only by the absence of collective action capable of opposing the employer's use of power; the basis of this guarantee is the absence of work group integration.

At the organisational level work is produced through employer control over the division of labour. This translates into task structure, relationships between tasks, task demands, the knowledge workers have of these, and their capacity to react independently of the influence of social relations at other levels.

The individual-member level refers to that part of the worker which is not organised, commanded or rewarded. It is made up of the autonomy that remains to the workers after the working through of the social relations to which they are submitted.

Greater details of this theoretical construction are given elsewhere (Dwyer, forthcoming).

A sociological interpretation of the industrial accidents literature

The rewards level is seen as producing accidents through factors such as financial incentives, long working hours, symbolic recompense, and the incapacity of poorly nourished workers to perform tasks in safety. No one of these factors by itself necessarily causes accidents, and the effects may be differentiated by sector or factory. For example, one Canadian study showed no link between financial incentives and accidents (Mason, 1977). This result seems in conflict with a study of Swedish mines and logging, where reductions in accident rates ranged from 30% to 95% after the abolition of financial incentives (Kronlund, 1973; anon, 1977). This difference is more apparent than real since for incentives to be effective, people must be oriented to work harder to earn them, and for incentives to produce more industrial accidents, greater risks must be taken to earn them. It is not the incentive as such that produces accidents but the actions of workers when faced with these. Other studies highlight the

use of symbolic rather than financial incentives to guarantee the performance of dangerous work (Haas, 1977; Freilich, 1970).

Extended work is another relevant social relation: people work longer hours than is safe or work beyond their physical capacities and, as a result, have an accident. However, job demands differ between sectors, and workers have different capacities. One illustration is provided by Solins (1976). He calculated that an increase of one hour in the working day resulted in a 30% rise in accidents in the metalworking sector, but no significant increase in the construction and clothing sectors. The accident rate of a predominantly Muslim group of construction workers in France went up by about 40% during the Ramadan fast (Grand and Laurent, 1969). Clearly, the adoption of a management strategy to change work scheduling during Ramadan to take account of the reduced capacities it causes would have a role to play in reducing accidents. In one spectacular example, an increase in the work week from 60 to 72 hours was associated with a two and a half fold increase in accidents (Vernon, 1918). Other research results link reductions in working hours to declines in accident rates.

The command level is not seen in much of the safety literature as having an important weight in accident production. An absence of workgroup integration (which can be called workgroup disintegration) was reported in Faverge (1967) to be responsible for 10% of accidents in three German steelworks (Neuloh, Ruhe and Graf 1957) and 5% of fatal construction accidents in a Parisian sample (Wisniewski, 1977). Greater integration, whether sponsored by employers or workers, could be expected to reduce such accidents. The acceptance of danger as a natural part of the task is seen in some management-oriented literature as a problem to be overcome (anon, 1982; Watson, 1986) and has been identified as a factor in the production of accidents by sociologists (Hopkins, 1984; Edwards and Scullion, 1982).

The absence of workgroup integration, frequently formalised as union power, can make it easier for the employer to resort to authoritarianism. For Carson (1982), employer action has reduced the effectiveness of unions on the British North Sea Oil fields, thereby contributing to their high accident rate. After the dismissal of what management called "agitators" in an

automobile factory, Turner, Clack and Roberts (1967) reported a 40% increase in accidents. In British coal mines, Hill and Trist (1955) tentatively attributed the reduction of accidents on night shift to there being less "authority" on this shift or, in terms discussed above, to a rise in employee auto-command. Raftery and Akman (1986) documented an abrupt three-fold decrease in the rate of disasters in British coalmines, occurring in 1890 shortly after the establishment of the National Union of Mineworkers.

Organisational level social relations produce the majority of work accidents in the advanced industrial nations. Monotony and boredom associated with the performance of routine work have been seen as responsible for accident production (Caillard, 1976; Raymond, 1952). Job rotation and enlargement are strategies adopted, formally or informally, to reduce the weight of routine.

Disorganisation appears as a factor that is increasingly "designed into" the more complex industrial and work processes; it can be seen as being at the origin of the Three Mile Island and the Challenger accidents (Perrow, 1984; Rogers, 1986). The traditional notion of "good housekeeping" expresses an idea of the absence of one form of disorganisation and that of "routine maintenance" embodies an employer strategy to avoid the delays and dangers that issue from another form. Disorganisation may produce demands on workers to perform corrective tasks for which they are inadequately trained. Non-usual tasks occupying 5% of worktime were found by Trautes, as reported by Faverge (1967), to be responsible for 60% of accidents. The role of underqualification in ordinary work settings has been examined: accident victims were found to have considerably less experience than non-victims working at matched tasks (Powell, Hale, Martin and Simon, 1971). A Swedish study cited by Faverge (1967) produced a similar result (Hagbergh-Olycksfall, 1960). The literature review of Ellis (1975) reported little evidence to support the claim that training reduces accidents. However, Quinot and Moyen (1980) make the opposite argument, seeing the future of accident prevention as intimately linked to the provision of better training. Consistent with this, North American studies of training report reductions in accidents by 50% in the chemicals and pulp and

paper industries (Collisson, 1964; US Bureau of Labour Statistics, 1971).

It has been claimed that the individual-member level causes accidents through accident proneness, individual carelessness and differentiated cognitive capacities. From the viewpoint of a sociological theory, which gives priority to social over individual explanations of social phenomena, it can be hypothesised that this level, on its own, accounts for few accidents.

Hypothesis formulation

We hypothesise that the management of workers' relationships to the dangers of the job through social relations at a given level will be associated with the production of accidents at that level. This is the key hypothesis that underlies our sociological approach. It implies that a reduction in the weight of a given level will be associated with a reduction in accidents at that level. Also, an increase in the weight of a level will be associated with a rise in accidents at that level. In addition, strategies, whether employer or employee promoted, that reduce the weight of social relations at a given level will be associated with reduced accident production at that level.

These last two hypotheses, that auto-control and managerial safety management reduce accident rates, are compatible with some of the literature that treats management (Shafai-Sharai, 1973; Cohen and Cleveland, 1983) and union involvement in safety (Turner, Clack and Roberts, 1967; Grunberg, 1983). In the context of our study they will lead to two propositions. These will be compared with hypotheses drawn from traditional perspectives on prevention to see if they have utility for explaining observed differences in accident rates.

METHOD AND DESIGN

The research is based on a case study approach and the use of mixed methods: semi-participant observation of the workplace, semi-structured interviews with staff at all levels and the analysis of company records and statistics. Such an approach to the study of work is a classical one for the social sciences but a rare one for the study of accidents (Faverge, 1967;

Leplat, 1978). Data gathered by one method is checked against that gathered by another in a process called triangulation (Denzin, 1970). For an explanation to be considered valid it must exhibit both causal and meaning adequacy (Schutz, 1967). In other words, hypotheses supported by written evidence such as statistics and reports, and by observational evidence, are considered valid only when they are congruous with the meanings actors attribute to their own actions. For example, a correlation between piecework and accidents does not constitute a sufficient basis for a sociological explanation. Those who are subject to piecework must themselves perceive the link between the two. Otherwise, alternative explanations must be sought.

The literature on shift work contains contradictory results and reveals no intrinsic link between night and day shifts and accidents (Smith, Colligan, Frookt and Tasto, 1979, Carter and Corlett, 1981.). Shiftwork constitutes a semi-experimental form of work in which, when it involves rotating schedules, workers, machines and materials stay the same between shifts. Given this, any observed differences between shifts in accident rates have to be explained in terms of factors that exclude reference to the workers, machines and materials, factors traditionally used by accident theory. In fixed shift schedules, machines and materials are controlled for. On the basis of such insights it was decided to carry out research into shiftwork. The research was carried out in New Zealand in seven manufacturing plants, five with rotating shifts and two with fixed shifts. At the time of the study, shiftwork was a male preserve, so our study did not involve any women workers. We conjecture that our results would generalize beyond male-only workplaces, however.

The seven plants were chosen because they represented certain technological types and management styles. Technologically the dominant production systems run from (a) semi-artisanal, through (b) semi-mechanised, to (c) continuous process production (Touraine, 1962). Management styles were of three types: (1) compacted management, in which employers did not resort to the use of the rewards level to intensify work and workers exhibited strong collective organisation at the command level; (2) traditional management, in which employers

managed through the use of incentive systems at the rewards level and workers were not collectively organised at the command level; and (3) induced management, in which employers managed through incentives at the rewards level and workers were strongly organised at the command level. Table 1 locates the plants and their variations in accident rates .

Table 1
Characteristics of plants and variations in accident rates (in accidents per 100,000 person shifts)

	Technological type		
	Semi-artisanal	Semi-mechanised	Continuous process
Compacted management	Plant A day=103 night=75	Plant C day=63 night=30	Plant B day=43 night=33
Traditional management	Plant D day=103 night=191	Plant E day=26 night=63	
Induced management		Plant F day=32 night=74 Plant G day=40 night=16	

For each shift (day/night) in each of the seven plants, 31 variables that can be hypothesised to affect accident rates were recorded. These are shown in Table 2 and explained in the Appendix. A preliminary report on the shiftwork study has been published elsewhere (Dwyer, 1980). The variables reflect sociological analysis carried out using the methods and explanatory criteria described above (v26-v31), organisational factors gathered on the basis of company records (v5-v9), measures of degrees of institutionalized industrial safety interventions gathered through interviews and company records (v19-v23), appreciations of diverse measures of plant danger based on interview and observational data (v15-v18), and potential

accident costs (v10). The presence of high potential accident costs as reflected in this last variable is frequently hypothesised to lead to managerial interventions in favour of safety. However, it is from variables 19-23 that tests of traditional approaches to safety can be found: frequency of government safety inspection (v19), type of formal safety management (v20), which is quite different to the sociological notion of managerial safety management, the operation of formal safety committees (v21), a measure of the role of industrial medicine (v22), and the formal role of unions in safety (v23). Some writers claim that factors such as strike rates, productivity, age of the workforce, systems of financial stimulants and type of shift system are associated with accident production, and data was gathered to permit such factors to be tested for. Given the resources of the study all types of traditional safety management have not been tested for; ergonomists will find it interesting that their discipline was not represented in any of the plants studied.

Accidents are defined as those recorded by companies as resulting in legally compensated lost working time as defined by a national standard, so that the definitional problems that would have occurred had non-lost time accidents been included are avoided. Plant management encountered some difficulties in obtaining precise data on the number of shifts, defined as standard eight-hour periods worked, but nowhere was such data so imprecise as to require the exclusion of the plant from the sample.

RESULTS

We first give a qualitative description of our data, and then proceed to statistical modeling.

The case studies: A qualitative treatment

The command level was not responsible for the production of the majority of accidents in any of the plants. Authoritarianism played an important role in the traditional management style. In the unionised plants it was used occasionally, notably in breakdown situations in the

Table 2

Conventional and Sociological Variables for Testing

	A day	A night	B day	B night	C day	C night	D day	D night	E day	E night	F day	F night	G day	G night
Shift: Day = 1 Night = 2 : V.1	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Process Type: V.2	1	1	3	3	2	2	1	1	2	2	2	2	2	2
Shift Type: 1 = rotating 2 = fixed : V.3	1	1	1	1	1	1	1	1	1	1	2	2	2	2
"Strike Ratio": V.4	1	1	3	3	1	1	3	3	3	3	2	2	1	1
Labor Turnover (2): V.5	2	2	2	2	2	2	1	1	1	1	2	1	2	1
Labor Turnover (1): V.6	1	1	1	1	2	2	9	9	7	7	2	4	3	5
Span of Control (1): V.7	18	16	17	14	11	13	14	13	20	18	13	13	18	29
Span of Control (2) V.8	6	16	9	14	5	13	5	13	5	18	8	13	12	29

	A day	A night	B day	B night	C day	C night	D day	D night	E day	E night	F day	F night	G day	G night
Number of Staff: V.9	42	33	38	30	39	27	17	14	25	19	44	28	78	60
Potential Cost of Accidents: V.10	1	1	1	1	2	2	1	1	2	2	3	3	2	2
Productivity: V.11	3	1	2	2	3	1	2	2	3	1	2	2	1	3
Age of Staff: V.12	2	2	2	2	2	2	2	2	2	2	3	1	3	1
Financial Incentives: V.13	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Control Style: V.14	1	1	1	1	1	1	2	2	2	2	3	3	3	3
Physical Danger: V.15	7	7	2	2	4	4	6	6	5	5	1	1	3	3
Danger of Materials: V.16	7	7	3	3	5	5	6	6	4	4	1	1	2	2
Saftey Devices: V.17	6	6	1	1	4	4	7	7	5	5	2	2	3	3
Danger of Process: V.18	2	2	1	1	1	1	2	2	1	1	2	2	1	1
Government Inspection: V.19	3	3	3	3	3	3	1	1	1	1	2	2	2	2
Safety Officers: V.20	1	1	1	1	1	1	2	2	2	2	2	2	2	2

	A day	A night	B day	B night	C day	C night	D day	D night	E day	E night	F day	F night	G day	G night
Safety Committees: V.21	3	3	1	1	1	1	3	3	3	3	2	2	2	2
First Aid: V.22	2	1	2	1	2	1	1	3	1	3	1	2	1	2
Union and Safety: V.23	1	1	2	2	1	1	3	3	3	3	1	1	1	1
Qualifications: V.24	1	1	2	2	2	2	1	1	2	2	2	2	1	1
Training: V.25	2	2	2	2	2	2	1	1	2	2	2	2	1	1
<u>Social Derivatives</u>														
Employee-Control: V.26	2	1	2	1	2	1	2	2	2	2	1	2	2	1
Workers + Incentives: V.27	0	0	0	0	0	0	2	3	2	3	1	3	3	1
<u>Social Relations + I-M</u>														
Organizational Level: V.28	2	1	2	1	2	1	1	2	1	2	1	2	2	1
Command Level: V.29	2	1	2	1	2	1	2	1	2	1	2	1	2	1
Rewards Level: V.30	2	1	2	1	2	1	1	2	1	2	1	2	2	1
Individual-Member Level: V.31	1	2	1	2	1	2	1	2	1	2	1	2	2	1

three plants without incentive systems, where it forced a prompt return of production. Management power functioned, almost universally, to reduce worker autonomy to act in terms of orientations developed in reaction to the rewards and organisational levels. In some plants, particularly those subject to traditional management, dangers had come to be accepted as normal; this directly produced diverse accidents such as cuts and burns. Workgroup disintegration, although seen as a potential source of danger in all except plant F, did not seem to produce accidents directly.

In plants A, B and C, in spite of the different technologies used, the drop in accident rates observed at night was always explained as being a result of reduced employer command pressure. From a sociological viewpoint such a reduction does not necessarily lead to a decline in accidents — it must be accompanied by appropriate changes in social relations. In these plants workers were both "safety conscious" and well organised in defense of their interests. At night, they resorted to auto-command, indicated by a more frequent refusal to work in situations defined as dangerous and by reducing employer recourse to authoritarianism. More importantly, this change articulated into their taking greater control of the management of other levels.

At the rewards level, extended work represented a potential problem in all plants. However, different employer policies resulted in differentiated potential effects of this relation. In the three plants with a compacted management style, union pressures had led to managerial decisions to substitute absent workers by replacement staff working a double shift period. In the plants subject to traditional management the absence of strong unions permitted short staffing to be used to bridge those gaps produced by absentees. In the remaining plants employers were able to resort to strategies unavailable elsewhere and they reacted to demands for adequate staffing mainly by shutting down individual machines. Extended work would appear to have the greatest weight in plants subject to compacted management.

On night shift, workers in plants A, B and C resorted to auto-rewards, taking advantage of the reduction in employer command power. Overly tired workers were spelled informally

by colleagues, a practice prohibited by management on day shift.

Systems of financial stimulants were used in four plants. In rotating shift plants D and E, workers were highly motivated by the incentives and inter-shift competitions; to reduce the negative effects of their actions employers resorted to command level safety management on day shift. When employer command pressure was less, workers on night shift could be seen and acknowledged taking greater risks to increase production levels, unlike their counterparts subject to compacted management. Workers' natural tiredness on night shifts coupled with the inexistence of any system, formal or informal, to spell overly tired workers also contributed to increase risks produced at the rewards level on this shift in both plants.

Plants F and G, subjected to induced management, showed contradictory patterns of accidents between shifts. This is linked to characteristics of fixed shifts: differentiated staff display different orientations and capacities when confronted with similiar changes in managerial control of social relations.

Plant F fits into the pattern already discussed. In spite of a generally high level of safety consciousness, night shift workers took risks in the absence of employer command power, to an extent determined by their favourable orientations to the earning of financial inducements. Day shift workers were older, on average, and, having already achieved a certain degree of financial security, were less favourably oriented to earn them than their younger night colleagues. Such an orientation was produced independently of the increased managerial control found on this shift. This is consistent with the results of Lindstrom and Sandstrom-Fisk (1976). Extended work could be expected to be produced among those workers whose daytime activities reduce their nocturnal capacities, but we were unable to ascertain any accident production issuing from this relation.

In spite of greater managerial command level presence, plant G day workers took greater risks because they were more favourably oriented towards the bonus system than their night counterparts. Task requirements were such that experience and ability, rather than effort, were the important ingredients in bonus earning. Recognising this, the more experienced day

workers displayed a more favourable orientation to bonus earning than their night colleagues. A relatively strong sense of safety values was present on both shifts, and these articulated into auto-rewards and safer work performance only at night.

At the organisational level underqualification presented itself in various forms and in varying degrees. It was most common where high labour turnover cooexisted with demands that a worker perform a large number or complex set of tasks. Formal training programmes were linked by interviewees to reductions in the relation's potential in some plants. Disorganisation because of breakdowns proved to be particularly chronic in plant C on day shift, minimal in plants E and F and varied between these extremes in the other plants. Routine was not a feature of the principal production tasks in the plants with a semi-artisanal process type or in plant E, where a large variety of products are made and the labour turnover rate is high. Elsewhere its weight in accident production varied; it was not seen as having an importance close to that of other organisational level relations. On night shift underqualification increased, raising the weight of the organisational level in plants D and E. This occurred because, in the absence of active unions, managements moved workers up the job hierarchy to cover for absentees; in this way inadequately qualified people were placed in jobs. Absenteeism was more common on the night shift, thereby increasing the weight of underqualification on this shift.

In plants A, B and C auto-organisation took place through strategies such as the rotation of routine tasks and the correction of disorganisation. The weight of organisational level relations declined as a result; in the continuous process plant B the decline was less pronounced than in plants A and C.

In plant F the weight of the organisational level increased at nights since workers repaired their own machines to counter inadequate maintenance; in this way underqualification was produced. Workers suggested that task monotony combined with night work would produce more accidents, but empirical data on this notion could not be obtained.

In plant G routine appeared to carry more weight on day shifts because the workers were more accustomed to their tasks than their less senior night counterparts.

In addition, the promotion structure resulted in the longer serving workers being placed in the most skilled and heaviest jobs. An articulation between the command and individual-member levels was thus produced which resulted in numerous back injuries, to the most skilled day shift workers; their younger night time counterparts suffered less such injuries.

The individual-member level proved to be important for accident production only in plant G where, as we have just seen, an organisational level decision relating to staff allocation, resulted in a large number of back injuries, which were produced in conjunction with the command level because perceived as a normal feature of the job. In other plants its importance rose slightly on night shift but the rise always appeared insufficient to produce observable effects on accident production.

Although reported here in a highly simplified form, these case studies have shown the complexity of the causal relations between the levels. The idea underlying the sociological theory of industrial accidents, that accidents are products of social relations and that they can be prevented by changing these relations, appears to find support in these case studies. Specific day-night changes in accident rates seemed to be linked to specific transformations in social relations.

The causal explanations developed proved meaningfully adequate for the workers studied; in this way the criterion of validity of explanation developed by Schutz (1967) was satisfied in a qualitative sense. The explanations herein presented were only constructed after considerable interchange between the sociologist and the research subjects. The latters' meaning constructs played a considerable role in modifying the causal connections made, and vice versa. The statistical tests provided here are but tests of the explanations developed. We note that the Schutzian criterion for explanation requires that the results of the statistical analyses be referred back to the workers to check that these meet their criteria of meaning adequacy, but this was not possible for practical reasons. Had this been done, the original meaning

constructs and causal connections could have been further modified. In this way the explanations built in the qualitative analysis might have been further tightened or loosened. Having outlined this limitation of the study let us now test the ideas developed more formally, using statistical models.

Statistical modelling

The variables used in our final statistical models are shown in Table 3 (extracted from Table 2). Our theory leads to two main hypotheses. The first is that accident rates will be low when auto-control is high and the weight of rewards, organization and command levels in management is low. The second hypothesis is that accident rates will be high when auto-control is low, the weight of rewards and organization is high, and employers do not engage in managerial safety management; empirically the latter coincided in our study with a low weight of the command level.

Table 3
Variables used in the final statistical models

Plant	Shift	Total shifts	Shifts w/acc.	Acc. rate	Danger level x_1	Employee-control x_2	Org./Rew. levels x_3	Command level x_4	x_5	x_6
A	Day	20402	21	103	7	2	2	2	0	0
	Night	18629	14	75	7	1	1	1	1	0
B	Day	23237	10	43	3	2	2	2	0	0
	Night	18134	6	33	3	1	1	1	1	0
C	Day	15836	10	63	5	2	2	2	0	0
	Night	13197	4	30	5	1	1	1	1	0
D	Day	2915	3	103	6	2	1	2	0	0
	Night	2098	4	191	6	2	2	1	0	1
E	Day	7717	2	26	4	2	1	2	0	0
	Night	4790	3	63	4	2	2	1	0	1
F	Day	28232	9	32	1	1	1	2	0	0
	Night	18821	14	74	1	2	2	1	0	1
G	Day	47641	19	40	2	2	2	2	0	0
	Night	38247	6	16	2	1	1	1	1	0

NOTE: The variables are defined as follows:
Shifts w/acc. = number of person shifts with at least one accident
Acc. rate = number of accidents per 100,000 person shifts
x_1 = danger of materials ranked among plants (1=low, 7=high)
x_2 = employee-control; see text (1=high, 2=low)
x_3 = weight of organisational and rewards levels (1=low, 2=high)
x_4 = weight of command level (1=low, 2=high)
x_5 is defined by equation (1)
x_6 is defined by equation (2).

The first hypothesis is quantified by defining the independent variable

$$x_5 = \begin{cases} 1 & \text{if } x_2=1, x_3=1 \text{ and } x_4=1 \\ 0 & \text{otherwise} \end{cases} . \qquad (1)$$

The second hypothesis corresponds to the variable

$$x_6 = \begin{cases} 1 & \text{if } x_2=2, x_3=2 \text{ and } x_4=1 \\ 0 & \text{otherwise} \end{cases} . \qquad (2)$$

The measurement of employee-control and the weights of the levels is not absolute, but rather an inter-shift comparison within each factory. We therefore study inter-shift differences in accident rates; these are not affected by machines and materials which remain the same between shifts. The workers are also unchanged between shifts, except at the two fixed shift plants, F and G.

We first transform the empirical accident rates to the arc-sine scale on which they are approximately normal (see, e.g., Johnson and Kotz, 1969, p. 65). If z = number of shifts with accidents and n = total number of shifts, then

$$z^* = \sin^{-1}\left[\sqrt{\frac{z+\frac{3}{8}}{n+\frac{3}{4}}}\right]$$

is the transformed accident rate. Our dependent variable is then $y = z_N^* - z_D^*$, for each plant. Here, a subscript N denotes the night shift and a subscript D denotes the day shift. The independent variable suggested by our theory is $x_5^* = x_{5N} - x_{5D}$. In our data, $x_6^* = 1 - x_5^*$, so that x_5^* expresses the full theoretical conception as operationalized in one variable; the effects of x_5 and x_6 cannot be distinguished. Below, however, we give an alternative analysis that does distinguish between the two effects. We base our conclusions here on weighted linear regression with weights equal to

$$\mathrm{Var}(y)^{-1} = \frac{4n_N\, n_D}{n_N + n_D}.$$

There was no significant overall difference between accident rates on the day and night shifts, although the overall rate was slightly (but not significantly) lower on night shift. Also, type of shift had no significant effects, and so we analyzed the rotating and fixed shift plants together. The test of our overall hypothesis thus consisted of weighted linear regression of y on x_5^*. The effect of x_5^* is both substantial and very highly significant. The regression coefficient has a t-value of -8.2, and the R^2 is 0.93. This can be interpreted as saying that the explanation constructed in terms of the sociological theory, using criteria of causal and

meaning adequacy, accounts for 93% of the variation in inter-shift differences in accident rates. By definition, these differences cannot be explained by more conventional factors such as machines, materials, workers or characteristics of the plants.

Logistic regression modeling

The analysis just reported establishes that the sociological theory explains a substantial amount of the variation in accident rates. However, it does not enable us to distinguish between the two components of the theory (x_5 and x_6), or to assess the relative explanatory power of competing hypotheses, most of which can explain only variation between plants, and not inter-shift differences.

We now report an alternative analysis which does enable us to do these things. Although the variables that specify the sociological theory have been measured in terms of comparisons between shifts in the same factory, we carry out an analysis that treats them as absolute measures. We then argue below that this yields valid conclusions for our data.

Let the probability of an accident on a given shift in a given plant be p. Then our model is the logistic regression model of Cox (1970), namely

$$\log\left[\frac{p}{1-p}\right] = \beta_0 + \sum_{i=1}^{m} \beta_i x_i, \qquad (3)$$

where $x_1, \ldots, x_m$ are independent variables and $\beta_0, \beta_1, \ldots, \beta_m$ are unknown parameters that have to be estimated from the data. This is best done by the method of maximum likelihood, which is implemented in the GLIM computer program (Baker and Nelder, 1978); see also McCullagh and Nelder (1989). This also yields tests via the sampling distribution of the deviance of the fitted model. The deviance is a generalisation of the residual sum of squares in linear regression.

We adopt a stepwise approach to choosing the independent variables in equation (3). To select the first independent variable for inclusion in the model, we fit a model with each of

the 33 candidate independent variables individually, and choose the one which most reduces the deviance, provided that the reduction is significant. The variable which fits best is x_1, danger of materials, which reduces the deviance by 41% for one degree of freedom (the % reduction in deviance is a generalisation of R^2). Other variables that were good predictors on their own included the physical danger of the plant, process type and the number of safety devices. However, each of these was highly correlated with danger of materials, and contributed little additional predictive power once danger of materials was controlled for. Thus, here we are taking x_1 as a general measure of the intrinsic danger of the work, or overall danger level.

To choose the second independent variable for inclusion in the model, we fit a model with each of the remaining 32 variables together with x_1, choosing the variable that reduces deviance the most from that left by x_1 alone. The variable that reduces deviance the most is x_6, followed closely by x_5. The variable x_6 reduces the deviance by half, to about 30% of its original value. Because x_5 and x_6 are complementary variables from the same theory, we next include x_5, which again reduces the deviance significantly.

The resulting model fits better than any other combination of two or three of the 33 possible independent variables (provided that x_1 is included, and that if x_6 is included so is x_5). It has a generalised R^2 of 0.85, revealing the power of the sociological explanation. The entire modeling process is summarised in Table 4 and the model predictions for each individual plant and shift are shown in Table 5. None of the individual differences between actual and predicted numbers of accidents is significant. Thus the model, which summarises the entire data set with only four parameters, fits the data well.

Table 4
Model-fitting results

Model	Deviance	Degrees of freedom	% of deviance explained (R^2)
All plants same	38.5	13	0
x_1	22.6	12	41
$x_1 + x_6$	11.4	11	70
$x_1 + x_6 + x_5$	5.6	10	85

Table 5
Number of accidents predicted by the model compared with the actual number

Plant	Shift	Number of accidents	
		Actual	Predicted
A	Day	21	21
	Night	14	11
B	Day	10	10
	Night	6	5
C	Day	10	11
	Night	4	5
D	Day	3	2
	Night	4	4
E	Day	2	4
	Night	3	6
F	Day	9	8
	Night	14	12
G	Day	19	17
	Night	6	8

The estimated parameters are shown in Table 6, together with their standard errors. All the parameters are highly significantly different from zero. We can interpret the model as follows:

(i) increasing x_1 by 1 increases p, the probability of an accident, by a factor of $e^{.21} = 1.23$, i.e. by about 23%;

(ii) increasing x_5 by 1 (i.e. going from a situation where $x_5=0$ to one where $x_5=1$) reduces p by a factor of $e^{-.51} = 0.60$, i.e. by about 40%;

(iii) increasing x_6 by 1 increases p by a factor of $e^{.75} = 2.11$, i.e. it more than doubles p.

Table 6
Parameter estimates for the fitted model

Parameter	Estimate	Standard error
Intercept	-8.34	
x_1	.21	.04
x_5	-.52	.22
x_6	.75	.25

One apparent difficulty with our final model is that x_5 and x_6 refer to inter-shift rather than absolute measurements. We now argue that this does not invalidate our conclusions. If this were a problem, a better model would also include base-line plant-specific effects, leading to a model of the form

$$\log\left[\frac{p_j}{1-p_j}\right] = \beta_0+\beta_5 x_{5j}+\beta_6 x_{6j}+\phi_j, \qquad (4)$$

where the subscript j refers to plant j. The quantities ϕ_j are then unknown, and measure the effects of the absolute (rather than relative) values of the sociological variables, x_5 and x_6. If the ϕ_j effects were large, this would lead to overdispersion (McCullagh and Nelder, 1989), one manifestation of which is that the deviance is substantially larger than the degrees of freedom. However, from Table 4, this is far from being the case, so the effect of the measurement of x_5 and x_6 being relative is small and does not invalidate the conclusions from our model. In any event, if the ϕ_j in equation (4) were important (and here they are not), then omitting them would lead us to underestimate the effects of the sociological variables.

The results confirm our hypothesis rather strongly. In a plant subject to a given danger level — a product of the "givens" assembled from outside — effective accident prevention is

produced by workers who exercise auto-control at all levels and by management which, in the absence of worker orientations favourable to auto-control, engages in safety management as defined sociologically. The small amount of unexplained variation provides support for our hypothesis that the autonomous operation of the individual-member level contributes little to the production of accidents. Indeed, although in qualitative research such as that conducted, the operation of the individual-member level proved difficult to gauge, the results obtained are consistent with the hypothesis that, after controlling for the danger of materials and the socio-logical factors, factors like "accident proneness", do not lead to any differences in accident rates between individual workers. This result stands in contrast with the frequent claim that individual characteristics account for 85% of all accidents (e.g. Heinrich, 1959).

IMPLICATIONS FOR ERGONOMICS

In one of the pioneering studies of safety expenditure using cost-benefit analysis, Rine-fort (1977) suggested that "the most effective mix ... would seem to be a balanced approach which combines both engineering and non-engineering and probably puts more emphasis upon the non-engineering aspects." One non-engineering approach that has shown its utility is a sociological approach. For the disciplines that seek to promote industrial safety this implies that worker-equipment interactions should be seen as mediated by social relations at the rewards, command and organisational levels.

Without increasing costs to competitive sector firms, certain changes in social relations have been shown in a series of semi-experimental studies to be associated with the production of fewer accidents. This has two practical consequences, one methodological and the other theoretical. Ergonomics should focus greater attention on workplace investigation. This methodological idea is not new, having been advocated by the Franco-Belgian ergonomist Faverge (1967) over twenty years ago. What is new is the theoretical support now available from sociology for this form of investigation.

Many disciplines have brought their contribution to the renewal that ergonomics is currently undergoing. This article is to be seen as a contribution from sociology. Indeed, the work of some ergonomists has been instrumental in building this sociological approach. Henceforth, ergonomists will be able to open a new horizon about accidents, reflecting on their production in terms of social relations.

A practical consequence of such analysis should be that ergonomic modifications to plant, equipment and processes be suggested only when their interaction with work relations has been considered. Furthermore, the investigation of the appropriateness of proposed technologies for existing or hypothesised patterns of social relations should become a basic consideration in each ergonomic intervention. The adoption of analytical dimensions such as these should enable the ergonomist's practical interventions to acquire a new efficacy. In the longer run such adoption, coupled with new theorisations that make explicit reference to sociological explanation may contribute to the formation of new theories in ergonomics.

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APPENDIX

Variables measured on the seven plants

The variables measured on the seven plants are shown in Table 2. They are as follows.

Variable 1. Shift. 1 = Day, 2 = night.

Variable 2. Process Type: 1 = process type (a) (semi-artisanal) 2 = process type (b) (semi-mechanised) 3 = process type (c) (continuous process)

Variable 3. Shift type. 1 = rotating, 2 = fixed.

Variable 4. Strike Rate: 1 = higher 2 = medium 3 = lower. Interview and (where available) statistical data were used to arrive at the ranking. (It represents differences between plants, and assumes identical treatment between shifts in the same plant).

Variable 5. Labour Turnover (1): 1 = higher 2 = lower, permits comparisons between shifts and between plants.

Variable 6. Labour Turnover (2): expressed in terms of the annual percentage of the work-force. eg. 3 = 30%

Variable 7. Span of Control (1): number of workers for each floor foreman.

Variable 8. Span of Control (2): number of workers for each foreman or other member of managerial staff normally located in the plant.

Variable 9. Number of Staff: the figure given is the number of workers, foremen and managers employed.

Variable 10. Potential Cost of Accidents: 1 = high 2 = medium 3 = low, the measures are relative between the plants.

Variable 11. Productivity: 1 = higher 2 = same 3 = lower, measures comparison between shifts in the same plant, based on interviews and records.

Variable 12. Age of Staff: 1 = higher 2 = same 3 = lower, values reflect the differences between shifts in same plant.

Variable 13. Financial Incentives: 1 = non-existent 2 = existent.

Variable 14. Control Style: 1 = compacted management 2 = traditional management 3 = Induced management.

Variable 15. Physical Danger: 1 = least dangerous 7 = most dangerous. The seven plants are ranked on the basis of a combination of observational and interview data. The overall dangers of products, processes etc. are reflected in this measure.

Variable 16. Danger of Materials: 1 = least dangerous 7 = most dangerous. The principal materials used are ranked on the same basis as v15..

Variable 17. Safety Devices: 1 = most safety devices 7 = least safety devices. The ranking is based on the researcher's assessment as to the extent to which plant or machinery design keeps workers "at a distance" from potential dangers.

Variable 18. Danger of Process: 1 = low 2 = high. a forced choice in which the relative dangers of the main production process are recorded.

Variable 19. Government Inspection: 1 = above average 2 = average 3 = below average. Based on interview data referring to the relative frequency of Department of Labour inspection.

Variable 20. Safety Officers: 1 = specialist 2 = non-specialist. All plants are overseen by safety officers of some type, these are distinguished by their function.

Variable 21. Safety Committees: 1 = safety committee exists and is judged (via interviews with workers) effective 2 = safety committee exists and is judged ineffective 3 = safety committee does not exist.

Variable 22. First Aid: 1 = above average 2 = average 3 = below average. The researcher's rating based on observation of differential services between both shifts and plants.

Variable 23. Union and Safety: 1 = active 2 = average 3 = inactive. This index was calculated on the basis of interview data on perceptions of union involvement in safety.

Variable 24. Qualifications: 1 = higher qualifications required to perform work adequately 2 = lower qualification is required.

Variable 25. Training: 1 = formal training schemes exist 2 = formal training schemes don't exist.

Variable 26. Worker Control: 1 = high control 2 = low control. The values expressed represent a response to the question: to what extent do workers control their own work relations in terms of an orientation whereby they seek to reduce accidents? Observational and interview data are used to form the measure.

Variable 27. Workers and Incentives: 0 = not applicable 1 = incentives offered and workers do not accept working dangerously to earn them 2 = incentives offered and workers accept working dangerously to earn them, but their actions are held in check by employer authority 3 = incentives are offered and workers act dangerously to earn them. Assessed on the basis of interview and observational data.

Variable 28. Organisational Level: 1 = lower 2 = higher, the values are relative between two shifts in the same plant. The attribution is made on the assumption that each level will dominate the functioning of work to a greater extent on one shift than on another. The value attributed is based on observational and interview data.

Variable 29. Command level. As Variable 28.

Variable 30. Rewards level. As Variable 28.

Variable 31. Individual-Member level. As Variable 28.

DWYER T. Life and death at work

1° Traduction partielle et commentaires

2° Analyse à paraître dans le Travail Humain

Textes de A. Wisner (Février 1993)

DWYER T. (1991) Life and death at work. Industrial accidents as a case of socially produced error PLENUM publ NEW-YORK 318 p.

Traduction partielle et commentaires

p. 5 - A ce point de sa réflexion, le sociologue devient plus précis : de quelle façon le problème est-il traité et comment les divers acteurs sociaux en définissent-ils le traitement, quelles ressources lui sont consacrées et quelles forces sont mobilisées, rejetées ou démobilisées dans la construction de modèles d'action qui deviennent éventuellement dominants ? Existe-t-il des éléments que l'on puisse localiser et qui puissent servir de bases à partir desquelles l'ampleur d'une action future puisse être accrue à partir des modèles dominants ? Ces questions sont assez générales pour guider une recherche sur les origines historiques d'autres notions modernes d'erreur.

p. 16 - L'attitude fondamentale du capitaliste industriel [par opposition au capitaliste traditionnel] est une orientation vers l'investissement dans les conditions de travail afin d'accroître la productivité et, de ce fait, le profit.

p. 18 - Beaucoup de travailleurs [mineurs] au début du XIXe siècle (invention de la lampe Davy en 1816) en particulier ceux qui étaient qualifiés, pensaient que la Science pouvait être un outil de l'émancipation humaine ... J'appellerai ces travailleurs qui étaient activement en faveur de l'usage de la technologie pour améliorer les conditions de travailleurs, des "travailleurs industriels".

p. 20 - Mr Thornley, un magistrat, s'aperçoit que les mineurs (les mineurs autonomes avaient perçu le danger lors de leur opposition initiale aux lampes Davy) étaient obligés de travailler dans des endroits qui avaient été considérés auparavant comme dangereux, comme comportant trop de gaz. Comment cela se produisit, nous ne le savons pas, qu'il s'agisse d'employeurs utilisant l'autoritarisme ou offrant des primes. L'effet important fut que la lampe fut imposée en dépit du jugement des [de certains] travailleurs.

p. 21 - Quand la performance objective de la lampe [Davy] devint plus importante que les critères "de vérité et de justice", il apparut une nouvelle légitimité. Le refus du travail est combattu par un instrument, le travail est progressivement objectivé et ainsi chaque instrument de ce type détruit une partie de la tradition culturelle. Le pouvoir

de traiter techniquement un danger est né et avec lui, la tradition culturelle de voir le danger comme une production sociale est menacée ...
Il existe six effets des instruments de sécurité conçus techniquement :

1) quand le dispositif produit un taux plus bas d'un accident défini techniquement (effet de l'investissement efficace)

2) Le dispositif peut ne pas obtenir une baisse du taux des accidents définis techniquement (effet de l'investissement inefficace)

3) Le dispositif technique existe, mais l'investissement nécessaire n'est pas fait, le taux demeure élevé (effet du non-investissement)

4) Les accidents définis n'existent pas. Il existe une différence entre les travailleurs pour lesquels le dispositif est utile et ceux pour lesquels il ne l'est pas (effet d'inégalité [de l'effet] de l'investissement).

5) La mesure technique peut produire de nouveaux accidents (effet des nouveaux accidents)

6) Les notions de vérité et de justice des travailleurs sont ébranlées (effet d'ébranlement des notions de vérité et de justice chez les travailleurs).

p. 22 - Au milieu du XIXe siècle, dans la puissance industrielle la plus importante (la Grande-Bretagne), 3 modèles distincts de la sécurité industrielle apparaissent. Le premier modèle, celui des capitalistes industriels qui cherchaient à accroître la productivité en investissant dans les conditions de travail, dont les dispositifs de sécurité, constituent un élément. Dans le second modèle, les capitalistes traditionnels refusaient d'investir dans la sécurité comme sans rapport avec le profit. Finalement, pour les travailleurs autonomes, c'est l'exercice de leur autonomie qui produisait la sécurité la plus grande.

p. 22 - Le modèle capitaliste industriel a gagné et devint le prototype de la sécurité industrielle dans le monde entier [ceci n'est tout simplement pas vrai car la même histoire se produit au cours de toute industrialisation avec des mentalités diverses des patrons et des ouvriers. Pourquoi Dwyer a-t-il abandonné son point de vue comparativiste ?]

p. 23 - en 1833, une Commission Royale du secteur industriel fut priée d'établir un système d'inspection organisé par l'Etat "surtout pour ceux des industriels qui désiraient que les heures de travail fussent réduites au niveau qu'ils avaient atteint" [C'est la bataille de la réglementation sociale à laquelle la Grande-Bretagne veut maintenant échapper en Europe, et c'est la volonté des P.V.D.I. d'échapper à la législation BIT. Ils déclarent que cette réglementation est un outil des P.D.I. pour empêcher leur concurrence] .

p. 150 - Hypothèses générales
La réalité de la plupart des situations de travail est que le travail est dirigé à plus d'un niveau et que les relations entre niveaux peuvent être simples à un moment donné et être complexes à un autre moment. Une théorie sociologique a été formulée et pendant le temps de son élaboration, de nombreuses hypothèses ont été soit suggérées, soit déduites. Elles peuvent toutes être vérifiées. Les 4 hypothèses principales les mieux établies sont les suivantes :

1) Les relations sociales au travail produisent des accidents du travail.
2) Plus lourd est le poids d'un certain niveau de relations sociales dans la gestion des relations des travailleurs avec les dangers de leur travail, plus grande est la proportion d'accidents à ce niveau.
3) Plus grand est le niveau d'auto-contrôle par les travailleurs à un niveau donné, plus faible est la proportion d'accidents produits au niveau que l'action des travailleurs tend à contrôler.
4) Plus grand est le degré de gestion de la sécurité par la direction à un certain niveau, plus basse se trouve être la proportion d'accidents produits à ce niveau que l'action de la direction cherche à contrôler.

p. 231 - Au début des années 80, les outils utilisés pour analyser le développement des diverses institutions durant notre siècle, ont cessé de paraître adéquats. Il semblait que les institutions se soient ouvertes et se soient orientées autrement. D'un point de vue analytique, l'examen de la prévention semblait devoir être accompli mieux en classant les activités selon 3 écoles qui pouvaient être considérées comme luttant entre elles pour influer sur le terrain laissé libre par la rupture. Aucune de ces écoles - l'approche par les normes, l'approche coût-bénéfice et la sécurité systémique - ne peut être considérée aujourd'hui comme exerçant une hégémonie similaire à celle qu'a connue l'ingénierie de la sécurité aux Etats-Unis ou les interventions publiques

ailleurs. Chaque école, à un degré ou un autre, a réussi à pénétrer les institutions de sécurité en transformant ainsi les termes du débat interne et les relations entre institutions.

La notion que les "écoles" en soient arrivées à remplacer les institutions comme l'élément clef d'analyse, est une idée nouvelle. Le terme d'école regroupe - doit-on le rappeler - les fonctionnaires, les spécialistes, les disciplines et sous-disciplines travaillant au sein d'espaces particuliers, politiquement définis. Chaque école a une approche particulière de l'analyse, chacune découpe transversalement les institutions et, de cette façon, permet aux membres de la même école de se fixer des objectifs communs en dépit de l'existence de frontières qui sont disciplinaires, professionnelles ou administratives.

Les changements institutionnels des années 70 ont contribué à la restauration de la paix sociale au sujet des accidents du travail. Toutefois, il apparaît que la crainte de nouveaux accidents, ceux qui tuent beaucoup plus de citoyens que de travailleurs, est ressentie dans les nations les plus avancées. Les citoyens mobilisés tendent à placer les coûts potentiels de tels accidents à un niveau si élevé que les firmes investissent pour prévenir les Bhopal, Three Mile Island et Seveso, pour éviter de prendre les vies du public. Une telle mobilisation augmente la préoccupation de l'industrie vis-à-vis de la prévention des accidents du travail en même temps que l'industrie cherche à convaincre le public que ses craintes sont sans fondements.

La structure de ce chapitre correspond à la construction et la mise en oeuvre d'un métier à tisser. Les écoles sont mises en situation de contraste l'une par rapport à l'autre. Par ailleurs, une série de remarques sont tissées : ces remarques portent sur les limites de chaque intervention, institution, changement institutionnel, social et économique, et correspond à une réflexion portant sur les données historiques. Quand le tissage s'arrête, une série d'impasses apparaissent à divers niveaux. En outre, certaines écoles sont reconnues comme des outils qui servent à l'émergence de forces sociales nouvelles. Ces observations demandent que l'on mette le tissu de côté et que l'on recommence en reprenant les fils négligés ou peu utilisés dans le tissage précédent. Les contours d'une nouvelle école d'analyse des accidents, de leur prévention et de leur compensation apparaissent alors de telle sorte que cette école rende compte d'une analyse sociologique du phénomène.

p. 251 - Le système de compensation du type Bismark a transféré le poids de la responsabilité des accidents du travail et de leur compensation des salariés aux employeurs. Maintenant, le système innovateur néozélandais déplace la responsabilité de la production des accidents des employeurs au progrès technologique et la responsabilité de leur compensation aux bénéficiaires du progrès, la société dans son ensemble.

p. 252 - reprendre les fils * : les changements de la compensation dans un contexte plus large

On peut émettre l'hypothèse que les développements comme ceux que nous avons évoqués sont produits par 3 transformations culturelles chez les acteurs : un changement dans la perception culturelle de la mort, une généralisation de la perception d'un accroissement des risques et la combinaison d'une confiance générale et d'une méfiance vis-à-vis des méthodes dominantes de gestion de ces risques. Pour arriver à une compréhension de cet ensemble apparemment complexe d'hypothèses de changement, j'ai besoin de faire d'importantes digressions afin de les examiner chacun à leur tour. En faisant cela, la préoccupation relative à la production d'accidents se joindra à celle de la compensation et à quelques-unes des bases sociales d'une éventuelle consolidation pour laquelle - faute de meilleurs termes - on emploiera le terme d'école sociologique de l'analyse des accidents et de la prévention. Dans cette discussion, on fera largement référence à la littérature nord-américaine sur la sécurité des systèmes.

Perception de la mort. Les attitudes vis-à-vis de la mort se sont transformées en Occident en parallèle avec le contrôle croissant sur la vie qui a été associé avec la croissance de la société industrielle, contrôle attribuable à des facteurs tels que l'épuration des eaux, l'hygiène et la santé publiques, et plus tard les vaccinations. Pour Philippe Aries, la mort de l'autre est devenue socialement plus importante que notre propre mort. Depuis le début du XXe siècle, Aries note un autre changement, l'apparition d'une attitude "moderne" vis-à-vis de la mort où la mort est "interdite" pour préserver le bonheur. Cette interdiction née aux Etats-Unis fut bâtie sur les ruines du puritanisme dans une culture urbanisée qui est dominée par la recherche du

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* L'expression : "reprendre les fils" est une allusion à la métaphore des métiers à tisser p. 234

bonheur liée à la recherche du profit. La mort change ainsi qualitativement avec l'accroissement de l'espérance de vie, le désir d'immortalité s'accroît et la lutte contre les accidents est considérée comme une lutte contre une mort laide.

p. 254 - Les craintes collectives d'exposition au risque

La croissance en importance de l'élite technocratique, peut être considérée comme un effet du changement culturel qui a créé de nouvelles exigences, exigences que l'élite déclare être capable de satisfaire. Des enquêtes américaines montrent que les citoyens se perçoivent comme exposés à des risques plus grands que dans le passé ...

Il est difficile de comprendre pourquoi le public se perçoit comme sujet à des risques plus grands que dans le passé. Aux Etats-Unis où les considérations relatives aux risques ont une importance politique et économique majeures, l'espérance de vie est de 72 ans, accroissement considérable par rapport à l'espérance de vie de 50 ans un siècle auparavant. Une observation aussi simple que celle que la coexistence de risques vitaux plus faibles et d'un accroissement des peurs constitue la base de tout un champ nouveau de recherche ...

p. 256 - L'absence de confiance du public dans les industries dangereuses a deux bases objectives : le secret et l'impression d'absence de contrôle public de la situation ...

p. 258 - Ainsi, pour Perrow, les risques devraient être contrôlables, leur potentiel de destruction réduit, on ne devrait utiliser que des matériaux comportant des risques relativement bien connus vis-à-vis de l'homme et les systèmes de production devraient être transparents. Pour Perrow, la réduction des couplages, le ralentissement et la simplification des activités réduiraient aussi bien les accidents que la crainte que l'on observe dans le public. Certaines technologies qui font très peur au public, ont en compensation peu d'avantages et reposent sur des systèmes de production ayant de hauts niveaux de capacités intrinsèques de défaillance et doivent être abandonnées.

p. 265 - La sécurité systémique : de l'auto-promotion aux effets pervers.

... Il est très probable que la demande pour la sécurité systémique va s'accroître à la suite de l'accident de Challenger, mais la sécurité systémique apparaît maintenant comme incapable de réaliser ses promesses, l'élimination des accidents. En fait, le

désir inhérent à la sécurité systémique, de l'importance des relations sociales dans la gestion des relations entre les travailleurs et leur travail, introduit de nouveaux problèmes. Des effets pervers telle que l'atteinte du sentiment de vérité et de justice des travailleurs, l'introduction de nouveaux types d'accidents, l'inégalité et les effets inefficaces des investissements, apparaissent à nouveau sur la scène.

Beaucoup de processus modernes de haute technologie sont conçus de telle façon qu'ils sont si complexes, si pleins d'inconnus et si étroitement connectés à la fois sur le plan fonctionnel et sur le plan temporel [comme le montre Perrow], que les travailleurs sont incapables d'acquérir les qualifications nécessaires pour exécuter le travail avec sûreté, et la direction est incapable de coordonner le travail de façon à prévenir des phénomènes étendus de désorganisation. La conception du processus de travail a rendu impossible aux travailleurs la construction de notions adéquates relatives à l'état du processus et au contrôle de danger pour bâtir un modèle de "vérité".

Le rapport Rasmussen de 1975 est un élément central de référence pour l'école systémique de sécurité et est utilisé fréquemment par ceux qui cherchent à vendre l'idée : les accidents de centrales nucléaires sont des situations proches de l'impossible. La Commission de Contrôle Nucléaire (Nuclear Regulatory Commission) des U.S.A. s'est montrée critique vis-à-vis de ce rapport du fait du traitement simpliste qu'il accorde aux accidents systémiques, types d'accidents propres aux systèmes complexes. Ce type d'accident que nous examinerons empiriquement apparaît comme largement ignoré par la littérature de sûreté systémique. Cela a conduit E.W. Hagen, un des directeurs du journal Nuclear Safety à observer que les spécialistes des accidents travaillent activement dans un domaine dont on n'a pas montré qu'il constituait le problème principal, ce dernier étant la complexité de ces systèmes en elle-même.

Charles Perrow fait une distinction entre les défaillances des composants et les accidents systémiques. Ces deux types d'accidents commencent par des défaillances d'instrument, mais dans les accidents systémiques, les défaillances multiples interagissent selon des modalités qui n'ont pas été prévues par les ingénieurs système et par ceux qui ont été formés à les utiliser, alors que dans les cas de défaillance de composants, les phénomènes peuvent être anticipés et compris ....

CONCLUSION

p. 268 - Toutes les industries considérées du point de vue de la sécurité systémique ont au moins un point commun : quand les travailleurs développent un sens de la vérité et connaissent les dangers de leur travail, ils peuvent décider de les accepter ou de les refuser. Ces industries peuvent différer selon deux aspects importants : d'abord, il peut se révéler impossible pour les travailleurs de développer une notion de vérité, et par ailleurs, les accidents peuvent inclure une exposition du public à de graves périls ...

... L'élite technocratique parle comme si elle, et elle seule, était l'incarnation de la raison et du progrès. Elle ignore les recommandations politiques du type de celles de Perrow, et se moque des conceptions populaires de vérité et de justice, des craintes de désastre et des demandes pour des contrôles socialement transparents des technologies. L'opposition montre le coût élevé - économique, politique et social - du développement technocratique de certains processus industriels et en faisant cela, a été capable de ralentir la réalisation de certains projets technocratiques ...

Des mouvements sociaux peuvent contraindre à l'abandon de l'énergie nucléaire, symbole de l'âge technocratique. Cependant, un tel abandon ne pourrait être considéré comme le signe d'une blessure mortelle du pouvoir technocratique. Ce dernier continuera à pénétrer toutes les sphères de la vie de diverses façons et un des modes de pénétration au poste de travail sera la sécurité systémique ... Inutile de dire que la plupart des spécialistes de la sécurité associés à cette école [systémique] continueront à exclure toute notion de production sociale des accidents ...

p. 270 - L'approfondissement de l'approche réglementaire, en particulier grâce à des règlements d'origine gouvernementale, représente une continuation de la solution weberienne à la notion marxiste du conflit de classe que les accidents industriels ont aidé à rendre visible. Le développement de l'école des coûts-bénéfices est une réponse au coût croissant de la solution weberienne du point de vue économique et social. Cette école cherche une solution dominée par la rationalité de l'économie du marché. L'école systémique - sous sa forme pure - cherche à construire une rationalité sociale qui dépasse les conflits économiques et politiques qui sous-tendent les autres approches, bien que son projet de planification et de programmation totales du processus de travail cherche à faire naître une orientation culturelle favorable à cette entreprise.

Nous avons vu que chacune de ces écoles a rencontré des impasses dans sa capacité de prévenir les accidents, ce qui soulève des questions sur la possibilité de changements. Au début des années 70 [une façon pudique de parler des événements de 1968 considérés par l'auteur comme la rupture], compte tenu de l'existence générale de forces de rupture, les perspectives politiques paraissaient favorables à l'émergence de changements fondamentaux ... En fait, ces forces demandant, par ailleurs, une plus grande participation des travailleurs, semblent avoir eu plus de succès pour obtenir une rigidification et une réorganisation de l'approche normative ...

p. 271 - VERS UNE NOUVELLE ECOLE

La vaste majorité des militants des mouvements sociaux se sont incorporés dans les 3 écoles. Ce qui, au début des années 1970, apparaissait comme une base politique potentielle pour une nouvelle école, est beaucoup moins net aujourd'hui ...

p. 275 - LE REAJUSTEMENT DU PRISME : LA REUNION DES FORCES POLITIQUES ET DES BASES INTELLECTUELLES ...

ELEMENTS DE LA SCENE POLITIQUE ...

EMPLOYEURS ...

... Dans "au-delà de la mécanisation", Hirschhorn a consacré un effort considérable à l'examen des équipes autonomes. En pensant à Three Miles Islands et à d'autres accidents sur des réacteurs nucléaires, il montre que "nous devons concevoir les situations de travail de telle sorte que les travailleurs puissent effectivement utiliser er les commandes, les modifier et les règler pour prévenir les défaillances et les erreurs que l'ingénieur n'avait pas anticipées". Il propose que, dans les systèmes, les travailleurs soient en état de constituer une vision cohérente de ce qui se passe dans leur domaine, et qu'ils aient la capacité de la corriger. Ces travailleurs doivent être en état de "comprendre les conséquences de leurs décisions de contrôle". Il développe encore son argument les nouvelles technologies exigent que nous développions une culture de l'apprentissage, une appréciation des phénomènes qui apparaissent et la compréhension du savoir tacite, un sens des relations intersubjectives et une appréciation de nos choix de conceptions organisationnelles".

Ce que Hirschhorn appelle "travail post-industriel" est géré avec succès quand les travailleurs ont la capacité de développer leurs propres notions de vérité et d'agir selon elles ...
Après avoir considéré les activités industrielles classiques en Suède, une discussion montre que la qualité de la vie de travail peut être améliorée quand les travailleurs assistent la direction dans les décisions d'investissement ...

p. 276 - UN INTERMEDE : L'EDUCATION A LA SECURITE ET LA NOTION DE VERITE CHEZ LES TRAVAILLEURS ...

... Dans quelles limites est-ce que l'idée que les travailleurs peuvent être éduqués à la sécurité contredit l'idée centrale dans ce livre - selon laquelle les travailleurs ont un sens de la vérité et de la justice qui les guide dans l'exécution de leur travail, et que, quand ils sont orientés vers une façon sûre d'agir, et qu'ils peuvent agir de façon autonome par rapport à la domination des forces sociales à d'autres niveaux, ils construisent une situation de travail sûre. La vérité est - nous l'avons vu - une notion qui se forme expérimentalement dans un contexte social; associée avec le sens de la justice, elle constitue une fondation d'une tradition culturelle. Dans les périodes de changement rapide, quand l'expérience d'un processus ou d'un matériau est faible, les chances des travailleurs d'obtenir un savoir fonctionnellement convenable sont réduites ...

p. 277 - ... Les relations sociales imprègnent la construction de la représentation de la sécurité chez les travailleurs. Par exemple, les travailleurs peuvent rejeter des dispositifs de protection qu'ils considèrent comme injustes, et créer alors de fausses notions de causalité qu'ils construisent comme ayant une valeur de vérité rationalisant ainsi leur rejet. [Avec une telle dialectique, on peut manipuler la notion de vérité et de justice chez les travailleurs au-delà du raisonnable] ... Pour que les explications causales puissent être considérées comme adéquates, il faut, dans la perspective développée dans ce livre, qu'elles soient confirmées en référence avec le système de signification des travailleurs. Ce processus éducatif "de haut en bas" est inversé par la logique de quelques études récentes où, au lieu d'accepter les définitions des causes de risque données par les professionnels, les chercheurs ont trouvé des données significatives grâce à des entretiens avec les travailleurs. Les résultats obtenus ainsi conduisent à la construction d'hypothèses causales ...

Les programmes "d'éducation" reposent souvent sur l'idée qu'il existe une seule vérité et sont considérés comme efficaces quand cette "vérité" est acceptée par les travailleurs. Un tel succès ne représente souvent rien d'autre que la soumission idéologique des salariés aux perspectives de la direction. Une telle conception est violemment opposée du point de vue adopté dans ce livre ...

p. 282 - ... Une telle évaluation conduit à une conclusion assez pessimiste au sujet des bases politiques possibles pour une école sociologique qui se trouve ainsi sur un terrain fragile. Ces bases sociales ont été désagrégées par un double processus grâce à la combinaison de la répression par le capital et les bureaucraties publiques et grâce à l'intégration dans les autres écoles où se trouvent la production et la transmission du savoir. Dans les comités et les représentations des travailleurs dans les situations de travail, c'est la paralysie scandaleuse du mouvement syndical qui est en cause [Ce genre d'appréciation ne me paraît ni scientifique, ni en particulier sociologique, mais politique et militant. En effet, la question scientifique-sociologique est celle de savoir pourquoi les syndicats sont paralysés dans ce domaine. Dwyer devrait réfléchir à la question fondamentale dans son domaine, du pouvoir dans les organisations et du changement des forces sociales depuis 1988 du fait de la transformation politique et économique du monde] ...

p. 284 - Ceux qui ont une expérience sociale des accidents, les voit traités en termes matériels. Ceux qui regardent les accidents à partir de conception de vérité et de justice sont considérés comme évoquant des valeurs par ceux qui affirment traiter la sécurité en accord avec les "faits". Le problème des relations sociales a été transformé en un problème que l'on peut résoudre par la négociation et l'administration. Mais une telle transformation a produit un vide entre travailleurs et syndicats. Une des conséquences de ce vide est la rupture : les travailleurs se heurtent non seulement aux hiérarchies syndicales en voulant une priorité plus forte pour la sécurité, mais aussi contre les approches actuelles de la sécurité - approches formulées activement ou passivement avec le soutien syndical.

p. 284 - UNE ECOLE NOUVELLE ET SOCIOLOGIQUE : REGARD FINAL ...

... Quand la majorité des accidents est produite par des primes de rendement, le rôle des interventions "techniques" est faible. Certaines formes de désorganisation et de sous-qualification peuvent émaner de l'incapacité de certaines structures des tâches à tenir compte des limites des performances humaines; dans de tels cas, les disciplines

comme l'ergonomie, la psychologie cognitive et la médecine peuvent chacune jouer un rôle analytique. De nouveaux instruments légaux peuvent distinguer les différents types de relations sociales. Par exemple, la production délibérée par les employeurs de la sous-qualification des travailleurs, doit être distinguée de l'offre habituelle de récompenses financières quand un procès a lieu pour prévenir ou punir la production d'accidents ... Le système judiciaire peut développer de nouveaux critères pour évaluer la responsabilité de l'employeur et des salariés dans la production d'accidents : les accidents produits par l'autoritarisme doivent être soumis à la législation criminelle, ceux qui sont produits par la routine à la législation pénale ...

"LE PUBLIC" : UN NOUVEL ACTEUR POLITIQUE ENTRE EN SCENE ...

p. 287 ... D'un point de vue sociologique, le "public" apparaît comme une catégorie trop nébuleuse pour être considéré comme un acteur social capable d'influencer les politiques de sûreté. Nous avons vu qu'il existait aux Etats-Unis un public qui résiste à certains types de développement parce qu'il éprouve une "terreur du risque". Cet effet est produit chez les gens qui se sentent soumis à des risques croissants, inconnus, inhabituels, incontrôlables, susceptibles de produire un grand nombre de morts et répartis inégalement. L'accroissement de la terreur du risque a été interprétée comme une réaction à la croissance du pouvoir technocratique, pouvoir lié à la sécurité systémique. Ceux qui éprouvent la terreur du risque sont considérés comme un segment d'un acteur, en préparation dans le domaine anti-technocratique, un acteur qui cherche à construire un pouvoir démocratique suffisamment fort pour se confronter avec un adversaire qui construit son pouvoir sur la base du savoir, renforcé par les outils de la complexité et du secret, un pouvoir qui cherche à soumettre tous les aspects de la consommation et de la production à ses plans.

[Et si la terreur du nucléaire était favorisée ou produite par les compagnies pétrolières qui n'aiment pas que l'on évoque l'énorme quantité de morts liée à la possession et au prix du pétrole (guerre d'Algérie, Liban, conflit irano-irakien, guerre du Koweit) ?].

DWYER T. (1991) Life and death at work. Industrial accidents as a case of socially produced error PLENUM pub NEW-YORK, 318 p.

Analyse à paraître dans le Travail Humain

Tom Dwyer est un sociologue néo-zélandais, d'origine irlandaise, qui, après des recherches sur le terrain en Nouvelle-Zélande et en France dans le domaine des accidents du travail dans le bâtiment, a soutenu sa thèse en France sur la genèse des accidents du travail, et enseigne maintenant à l'Université de Campinas au Brésil. Dans "Life and death at work", Tom Dwyer reprend et structure l'ensemble de ses travaux tous orientés vers l'analyse des accidents du travail considérés d'un point de vue sociologique.

Le livre de Tom Dwyer bénéficie d'une documentation considérable. Plus de 700 notes réfèrent à des travaux d'autres auteurs qui sont plus ou moins longuement commentés. L'usage que le lecteur peut faire de cette remarquable bibliographie est toutefois rendu quelque peu malaisé du fait de l'absence d'une liste alphabétique des auteurs cités en référence.

La documentation ainsi réunie par l'auteur lui permet de tracer un historique de la représentation des accidents du travail et de la lutte contre ceux-ci. Il décrit cette histoire comme une suite de crises séparées par des paliers où les solutions élaborées par la société à la suite des crises demeurent acceptées.

Après une période pré-industrielle où l'accident apparaît comme le résultat d'un mauvais sort ou des péchés de l'humanité, la croissance rapide de la fréquence des accidents bien étudiée dans les mines de charbon britanniques au début du XIXe siècle, conduit à la création de la prévention technique réglementaire. Pour Tom Dwyer "l'approfondissement de l'approche réglementaire, en particulier grâce à des règlements d'origine gouvernementale représente une continuation de la solution weberienne à la notion marxiste de conflit de classe que les accidents du travail ont aidé à rendre visible. Le développement de l'école des coûts-bénéfices en matière de sécurité du travail est à son tour une réponse au coût croissant de la solution weberienne du point de vue économique et social; l'école coût-bénéfices cherche à construire une solution dominée par la rationalité de l'économie de marché. L'école

systémique - sous sa forme pure - cherche à construire une rationalité sociale qui dépasse les conflits économiques et politiques qui sous-tendent les autres approches. Son projet de planification et de programmation totales du processus de travail, tend à faire naître une orientation culturelle favorable à cette entreprise". Les recherches ergonomiques et psychologiques sur la fiabilité humaine dont le rapport Rasmussen (1975) est le texte le plus connu, font partie intégrante de l'approche systémique.

Dans chaque institution de prévention, les 3 écoles réglementaire, coûts-bénéfices et systémique se trouvent représentées, mais elles ne satisfont ni les travailleurs ni les public. Chacune des écoles a conduit à des impasses dans sa capacité de prévenir les accidents ce qui soulève des questions sur les possibilités de changement. Au début des années 70 [une façon pudique pour Tom Dwyer d'évoquer les événements de 1968 considérés par l'auteur comme la rupture], compte tenu de l'existence générale des forces de rupture, les perspectives politiques apparaissaient favorables à l'émergence de changements fondamentaux. En fait, ces forces demandant par ailleurs, une plus grande participation des travailleurs, semblent avoir eu plus de succès pour obtenir une rigidification et une réorganisation de l'approche normative.

Pour faire réussir l'école sociologique des accidents du travail que Tom Dwyer a créée et veut développer, l'apparition du "public" dans le champ des accidents est essentielle. Il existe, en particulier aux Etats-Unis, un "public" qui résiste à certains types de développements techniques parce qu'il éprouve une "terreur du risque". Cet effet se produit quand les personnes se sentent exposées à des risques croissants, inconnus, inhabituels, incontrôlables et susceptibles de produire un grand nombre de morts. L'accroissement de la "terreur du risque" peut être interprétée comme une réaction à la croissance du pouvoir technocratique, pouvoir lié à la sécurité systémique, et dont l'arrogance se trouve contredite par les catastrophes des dernières années.

L'école sociologique comporte pour Tom Dwyer 4 hypothèses principales :

1) Les relations sociales au travail produisent des accidents du travail.
2) Plus lourd est le poids d'un certain niveau des relations sociales dans la gestion des relations des travailleurs avec les dangers de leur travail, plus grande est la proportion d'accidents produits à ce niveau.

3) Plus fort est le niveau d'auto-contrôle par les travailleurs à un niveau donné, plus faible est la proportion d'accidents produits au niveau que l'action des travailleurs peut contrôler.
4) Plus grand est le degré de gestion de la sécurité par la direction à un niveau donné, plus basse est la proportion d'accidents produits au niveau que la direction tend à contrôler.

Quelle que soit la valeur de ces hypothèses précises, tout chercheur, tout observateur qui a étudié le travail sur le terrain sait combien les forces sociales distordent dans la réalité les règles que chacune des 3 écoles antérieures ont émises. La nécessité d'une approche sociologique de la constitution du risque à tous les niveaux de la conception, de l'organisation et de la gestion du travail, nous paraît donc réelle, et le livre de Tom Dwyer apporte une contribution significative à cette approche.

Un autre élément essentiel de la pensée de Tom Dwyer est l'existence chez les travailleurs d'un "sentiment de vérité et de justice". Cette affirmation de l'auteur correspond au retour très intéressant de la morale sous la forme de l'éthique dans les réflexions actuelles sur la société. Ceux qui sont attachés à l'analyse ergonomique du travail, c'est-à-dire à la description du travail réel, ne peuvent qu'apprécier les concepts de vérité et de justice tels que Tom Dwyer les évoque, mais il faudrait établir des règles précises pour que le franchissement des limites de l'observation objective ne conduise pas à une manipulation sociale des valeurs que Tom Dwyer invoque. Il n'y a, par contre, pas de danger si l'on suit avec les ergonomistes, les recommandations de Hirschhorn cité par Dwyer. "Dans les systèmes qu'ils utilisent, les travailleurs doivent être en état de constituer une vision cohérente de ce qui se passe et de corriger le fonctionnement du système. Ces travailleurs doivent être en état de comprendre les conséquences de leurs décisions de contrôle".

La réflexion de Tom Dwyer sur le sentiment de vérité et de justice prend toute sa valeur quand l'auteur aborde la formation à la sécurité. "La vérité est une notion qui se forme expérimentalement dans un contexte social; associée avec le sens de la justice, elle constitue une fondation d'une tradition culturelle. Mais, dans les périodes de changement rapide, quand l'expérience d'un processus ou d'un matériau est faible, les chances des travailleurs de constituer un savoir fonctionnellement convenables sont réduites ..."

Les thèmes qui viennent d'être évoqués brièvement sont loin de constituer le seul contenu de ce livre d'une grande richesse, fruit d'une culture très vaste qui va de l'histoire de l'invention et de l'usage de la lampe Davy en 1816, à l'évolution du sentiment de la mort dans le monde moderne comme le montre Philippe Aries. Ce qui est très rare dans un livre appartenant à la littérature anglo-américaine, c'est de trouver autant de rapprochements judicieux entre auteurs de langue anglaise et auteurs français (Crozier, Faverge, Touraine, Quinot, Queré, Cottereau, Lenoir, Valentin, Dejours, Laville, Montmollin, Roustang, Mottez, Leplat, Cuny, etc ...). On peut avoir ainsi une image très intéressante des convergences et divergences des modes de pensée qui sont les nôtres avec la littérature de langue anglaise.

La lecture attentive du livre complexe de Tom Dwyer est d'une grande utilité, non seulement pour les sociologues du travail ou les spécialistes de la sécurité du travail, mais pour tous ceux qui cherchent à comprendre où se situent le ou les fils de leurs recherches et de leurs pratiques dans le tissu multicolore du travail pour emprunter à Tom Dwyer l'une de ses métaphores.

A. Wisner

Tom DWYER

p 99 – Qui produit le sentiment de vérité et de justice. Est-ce la morale (divine) est-ce un produit culturel ou sociologique et donc ce cas d'art de l'éthique.

– Par ailleurs, vous dites quelque part que les accidents du travail ne peuvent être négociable et vous montrez p 99 combien dialectique est la relation à la sécurité

p 129 Je ne peux adhérer à l'hypothèse selon laquelle plus la direction agit sur la relation entre le travailleur et la machine plus les accidents sont nombreux

p 129 et suivantes qui est dit sur l'organisation est proche de ce que je pense. Mais on ne trouve nulle part l'ombre du management, scientifique ou technique (3 Mile Island), du management local (Union américaine CLUSA, TAO). Il y a absence de l'« underground feeling » (p 131) dans les niveaux élevés et bas élevés.

Bhopal Tchernobyl

rell ~~de~~ HIRSCH HORN (275) et Truth (DWYER)
l'éthique au travail (DEJOURS, CHICO ANTUNES
Lire

p 21, il y a une affirmation implicite sans aucune gradation selon laquelle le jugement des travailleurs avec la langue DAVY était juste. C'est de par ailleurs comme ce sont vos concepts de "truth and justice". Il ne faut pas confondre morale et éthique.

Ergonomie p 60 CGT? non CFDT

RENAULT entreprise publique

non environnement agressif

parler de travail non valeurs

méthode française intérieur non comportement

AET

D.W qui mais surtout lien avec la science

d'abord labo (à l'anglaise ou américain) puis

AET

p 61 aux USA cognitif ergonomie

changement avec Scandinave

Importance des Scandinaves

d 74.75 Pourquoi ? jugement moral sur les syndicats

DWYER Tom. (1991) Life and death at work
PLENUM [mel] NEW YORK

Le livre est passionnant et proche de nos réflexions. Nous arrivons au même résultat

1° en pensant que les actes des travailleurs passent par leur représentation au regard des contraintes pragmatiques telles qu'il se les représente

2° en posant la question de l'erreur d'organisation à tous les niveaux

Mais ce n'est pas vrai que les travailleurs peuvent tout ressentir simplement

1° inconscient cognitif
2° inconscient psychique DEJOURS
3 travailler et alcool drogue.
4 préjugés culturels

} accidents de travail

Ils donnent une grande place au manque de (?) seuls (DANIELLOU) communication parfois faible (LEDA CUBATMO) parfois difficile (langage)

3. le remède est le même dans nos équipes de ce qui se passe vraiment : travail

TOM DWYER
idents Questiao Politica"

2 Mai 92
JORNAL DA TARDE
Lecture du 20.5.92

Le suis les idées de TOM DWYER qui sont en grande partie justes. En outre quand on prend le parti de donner des explications de type sociologique ou politique, on ne peut jamais être refuté car peu les partisans de cette approche, soit en sociologie ou politique

voir p 96 du livre

Il y a deux défauts de cette approche que je partage en grande partie

1°) Cela dégage la responsabilité des sociologues, des sociologues et des directeurs que j'ai au contraire montrés dans le travail face aux systèmes complexes et dangereux dans des systèmes scolaires sociétiques, mauvais conception des régulations (3 Rôles Ireland et PERROW, mauvais effet de la structure des centrales (Blocpal) de la pression d'une seule centrale Nationale.

TBSVP

2) La consultation sera par questionnaire
Qui donnera de la force aux syndicats s'ils
n'en ont pas ? Qui rendra la parole aux
PME (90% des employés) sensibles aux
revendications de T. D.

Son approche est juste mais il néglige
les moyens d'action, il ne s'intéresse pas
à la mobilisation comme font les partis
politiques. Comment changer l'air sans
vitesse ?

UNICAMP

5.V.92

Cher Alain Winer,

je crois que cet article pourrait vous interesser.

A la fin de mois vous venez à São Paulo, peut-être qu'on pourrait manger ensemble un soir?

Mon numéro de telephone est (011) 257.46.38.

à bientôt j'espère,

Tom Dwyer

Universidade Estadual de Campinas
Caixa Postal 1170 6110
13081 ~~13100~~ Campinas SP Brasil

Telefone: PABX (0192) 39-1301
Telex: (019) 1150

DWYER T. Life and death at work

1° Traduction partielle et commentaires

2° Analyse à paraître dans le Travail Humain

Textes de A. Wisner (Février 1993)

DWYER T. (1991) Life and death at work. Industrial accidents as a case of socially produced error PLENUM publ NEW-YORK 318 p.

Traduction partielle et commentaires

p. 5 - A ce point de sa réflexion, le sociologue devient plus précis : de quelle façon le problème est-il traité et comment les divers acteurs sociaux en définissent-ils le traitement, quelles ressources lui sont consacrées et quelles forces sont mobilisées, rejetées ou démobilisées dans la construction de modèles d'action qui deviennent éventuellement dominants ? Existe-t-il des éléments que l'on puisse localiser et qui puissent servir de bases à partir desquelles l'ampleur d'une action future puisse être accrue à partir des modèles dominants ? Ces questions sont assez générales pour guider une recherche sur les origines historiques d'autres notions modernes d'erreur.

p. 16 - L'attitude fondamentale du capitaliste industriel [par opposition au capitaliste traditionnel] est une orientation vers l'investissement dans les conditions de travail afin d'accroître la productivité et, de ce fait, le profit.

p. 18 - Beaucoup de travailleurs [mineurs] au début du XIXe siècle (invention de la lampe Davy en 1816) en particulier ceux qui étaient qualifiés, pensaient que la Science pouvait être un outil de l'émancipation humaine ... J'appellerai ces travailleurs qui étaient activement en faveur de l'usage de la technologie pour améliorer les conditions de travailleurs, des "travailleurs industriels".

p. 20 - Mr Thornley, un magistrat, s'aperçoit que les mineurs (les mineurs autonomes avaient perçu le danger lors de leur opposition initiale aux lampes Davy) étaient obligés de travailler dans des endroits qui avaient été considérés auparavant comme dangereux, comme comportant trop de gaz. Comment cela se produisit, nous ne le savons pas, qu'il s'agisse d'employeurs utilisant l'autoritarisme ou offrant des primes. L'effet important fut que la lampe fut imposée en dépit du jugement des [de certains] travailleurs.

p. 21 - Quand la performance objective de la lampe [Davy] devint plus importante que les critères "de vérité et de justice", il apparut une nouvelle légitimité. Le refus du travail est combattu par un instrument, le travail est progressivement objectivé et ainsi chaque instrument de ce type détruit une partie de la tradition culturelle. Le pouvoir

de traiter techniquement un danger est né et avec lui, la tradition culturelle de voir le danger comme une production sociale est menacée ...
Il existe six effets des instruments de sécurité conçus techniquement :

1) quand le dispositif produit un taux plus bas d'un accident défini techniquement (effet de l'investissement efficace)

2) Le dispositif peut ne pas obtenir une baisse du taux des accidents définis techniquement (effet de l'investissement inefficace)

3) Le dispositif technique existe, mais l'investissement nécessaire n'est pas fait, le taux demeure élevé (effet du non-investissement)

4) Les accidents définis n'existent pas. Il existe une différence entre les travailleurs pour lesquels le dispositif est utile et ceux pour lesquels il ne l'est pas (effet d'inégalité [de l'effet] de l'investissement).

5) La mesure technique peut produire de nouveaux accidents (effet des nouveaux accidents)

6) Les notions de vérité et de justice des travailleurs sont ébranlées (effet d'ébranlement des notions de vérité et de justice chez les travailleurs).

p. 22 - Au milieu du XIXe siècle, dans la puissance industrielle la plus importante (la Grande-Bretagne), 3 modèles distincts de la sécurité industrielle apparaissent. Le premier modèle, celui des capitalistes industriels qui cherchaient à accroître la productivité en investissant dans les conditions de travail, dont les dispositifs de sécurité, constituent un élément. Dans le second modèle, les capitalistes traditionnels refusaient d'investir dans la sécurité comme sans rapport avec le profit. Finalement, pour les travailleurs autonomes, c'est l'exercice de leur autonomie qui produisait la sécurité la plus grande.

p. 22 - Le modèle capitaliste industriel a gagné et devint le prototype de la sécurité industrielle dans le monde entier [ceci n'est tout simplement pas vrai car la même histoire se produit au cours de toute industrialisation avec des mentalités diverses des patrons et des ouvriers. Pourquoi Dwyer a-t-il abandonné son point de vue comparativiste ?]

p. 23 - en 1833, une Commission Royale du secteur industriel fut priée d'établir un système d'inspection organisé par l'Etat "surtout pour ceux des industriels qui désiraient que les heures de travail fussent réduites au niveau qu'ils avaient atteint" [C'est la bataille de la réglementation sociale à laquelle la Grande-Bretagne veut maintenant échapper en Europe, et c'est la volonté des P.V.D.I. d'échapper à la législation BIT. Ils déclarent que cette réglementation est un outil des P.D.I. pour empêcher leur concurrence] .

p. 150 - Hypothèses générales
La réalité de la plupart des situations de travail est que le travail est dirigé à plus d'un niveau et que les relations entre niveaux peuvent être simples à un moment donné et être complexes à un autre moment. Une théorie sociologique a été formulée et pendant le temps de son élaboration, de nombreuses hypothèses ont été soit suggérées, soit déduites. Elles peuvent toutes être vérifiées. Les 4 hypothèses principales les mieux établies sont les suivantes :

1) Les relations sociales au travail produisent des accidents du travail.
2) Plus lourd est le poids d'un certain niveau de relations sociales dans la gestion des relations des travailleurs avec les dangers de leur travail, plus grande est la proportion d'accidents à ce niveau.
3) Plus grand est le niveau d'auto-contrôle par les travailleurs à un niveau donné, plus faible est la proportion d'accidents produits au niveau que l'action des travailleurs tend à contrôler.
4) Plus grand est le degré de gestion de la sécurité par la direction à un certain niveau, plus basse se trouve être la proportion d'accidents produits à ce niveau que l'action de la direction cherche à contrôler.

p. 231 - Au début des années 80, les outils utilisés pour analyser le développement des diverses institutions durant notre siècle, ont cessé de paraître adéquats. Il semblait que les institutions se soient ouvertes et se soient orientées autrement. D'un point de vue analytique, l'examen de la prévention semblait devoir être accompli mieux en classant les activités selon 3 écoles qui pouvaient être considérées comme luttant entre elles pour influer sur le terrain laissé libre par la rupture. Aucune de ces écoles - l'approche par les normes, l'approche coût-bénéfice et la sécurité systémique - ne peut être considérée aujourd'hui comme exerçant une hégémonie similaire à celle qu'a connue l'ingénierie de la sécurité aux Etats-Unis ou les interventions publiques

ailleurs. Chaque école, à un degré ou un autre, a réussi à pénétrer les institutions de sécurité en transformant ainsi les termes du débat interne et les relations entre institutions.

La notion que les "écoles" en soient arrivées à remplacer les institutions comme l'élément clef d'analyse, est une idée nouvelle. Le terme d'école regroupe - doit-on le rappeler - les fonctionnaires, les spécialistes, les disciplines et sous-disciplines travaillant au sein d'espaces particuliers, politiquement définis. Chaque école a une approche particulière de l'analyse, chacune découpe transversalement les institutions et, de cette façon, permet aux membres de la même école de se fixer des objectifs communs en dépit de l'existence de frontières qui sont disciplinaires, professionnelles ou administratives.

Les changements institutionnels des années 70 ont contribué à la restauration de la paix sociale au sujet des accidents du travail. Toutefois, il apparaît que la crainte de nouveaux accidents, ceux qui tuent beaucoup plus de citoyens que de travailleurs, est ressentie dans les nations les plus avancées. Les citoyens mobilisés tendent à placer les coûts potentiels de tels accidents à un niveau si élevé que les firmes investissent pour prévenir les Bhopal, Three Mile Island et Seveso, pour éviter de prendre les vies du public. Une telle mobilisation augmente la préoccupation de l'industrie vis-à-vis de la prévention des accidents du travail en même temps que l'industrie cherche à convaincre le public que ses craintes sont sans fondements.

La structure de ce chapitre correspond à la construction et la mise en oeuvre d'un métier à tisser. Les écoles sont mises en situation de contraste l'une par rapport à l'autre. Par ailleurs, une série de remarques sont tissées : ces remarques portent sur les limites de chaque intervention, institution, changement institutionnel, social et économique, et correspond à une réflexion portant sur les données historiques. Quand le tissage s'arrête, une série d'impasses apparaissent à divers niveaux. En outre, certaines écoles sont reconnues comme des outils qui servent à l'émergence de forces sociales nouvelles. Ces observations demandent que l'on mette le tissu de côté et que l'on recommence en reprenant les fils négligés ou peu utilisés dans le tissage précédent. Les contours d'une nouvelle école d'analyse des accidents, de leur prévention et de leur compensation apparaissent alors de telle sorte que cette école rende compte d'une analyse sociologique du phénomène.

p. 251 - Le système de compensation du type Bismark a transféré le poids de la responsabilité des accidents du travail et de leur compensation des salariés aux employeurs. Maintenant, le système innovateur néozélandais déplace la responsabilité de la production des accidents des employeurs au progrès technologique et la responsabilité de leur compensation aux bénéficiaires du progrès, la société dans son ensemble.

p. 252 - reprendre les fils * : les changements de la compensation dans un contexte plus large

On peut émettre l'hypothèse que les développements comme ceux que nous avons évoqués sont produits par 3 transformations culturelles chez les acteurs : un changement dans la perception culturelle de la mort, une généralisation de la perception d'un accroissement des risques et la combinaison d'une confiance générale et d'une méfiance vis-à-vis des méthodes dominantes de gestion de ces risques. Pour arriver à une compréhension de cet ensemble apparemment complexe d'hypothèses de changement, j'ai besoin de faire d'importantes digressions afin de les examiner chacun à leur tour. En faisant cela, la préoccupation relative à la production d'accidents se joindra à celle de la compensation et à quelques-unes des bases sociales d'une éventuelle consolidation pour laquelle - faute de meilleurs termes - on emploiera le terme d'école sociologique de l'analyse des accidents et de la prévention. Dans cette discussion, on fera largement référence à la littérature nord-américaine sur la sécurité des systèmes.

Perception de la mort. Les attitudes vis-à-vis de la mort se sont transformées en Occident en parallèle avec le contrôle croissant sur la vie qui a été associé avec la croissance de la société industrielle, contrôle attribuable à des facteurs tels que l'épuration des eaux, l'hygiène et la santé publiques, et plus tard les vaccinations. Pour Philippe Aries, la mort de l'autre est devenue socialement plus importante que notre propre mort. Depuis le début du XXe siècle, Aries note un autre changement, l'apparition d'une attitude "moderne" vis-à-vis de la mort où la mort est "interdite" pour préserver le bonheur. Cette interdiction née aux Etats-Unis fut bâtie sur les ruines du puritanisme dans une culture urbanisée qui est dominée par la recherche du

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* L'expression : "reprendre les fils" est une allusion à la métaphore des métiers à tisser p. 234

bonheur liée à la recherche du profit. La mort change ainsi qualitativement avec l'accroissement de l'espérance de vie, le désir d'immortalité s'accroît et la lutte contre les accidents est considérée comme une lutte contre une mort laide.

p. 254 - Les craintes collectives d'exposition au risque

La croissance en importance de l'élite technocratique, peut être considérée comme un effet du changement culturel qui a créé de nouvelles exigences, exigences que l'élite déclare être capable de satisfaire. Des enquêtes américaines montrent que les citoyens se perçoivent comme exposés à des risques plus grands que dans le passé ...

Il est difficile de comprendre pourquoi le public se perçoit comme sujet à des risques plus grands que dans le passé. Aux Etats-Unis où les considérations relatives aux risques ont une importance politique et économique majeures, l'espérance de vie est de 72 ans, accroissement considérable par rapport à l'espérance de vie de 50 ans un siècle auparavant. Une observation aussi simple que celle que la coexistence de risques vitaux plus faibles et d'un accroissement des peurs constitue la base de tout un champ nouveau de recherche ...

p. 256 - L'absence de confiance du public dans les industries dangereuses a deux bases objectives : le secret et l'impression d'absence de contrôle public de la situation ...

p. 258 - Ainsi, pour Perrow, les risques devraient être contrôlables, leur potentiel de destruction réduit, on ne devrait utiliser que des matériaux comportant des risques relativement bien connus vis-à-vis de l'homme et les systèmes de production devraient être transparents. Pour Perrow, la réduction des couplages, le ralentissement et la simplification des activités réduiraient aussi bien les accidents que la crainte que l'on observe dans le public. Certaines technologies qui font très peur au public, ont en compensation peu d'avantages et reposent sur des systèmes de production ayant de hauts niveaux de capacités intrinsèques de défaillance et doivent être abandonnées.

p. 265 - La sécurité systémique : de l'auto-promotion aux effets pervers.

... Il est très probable que la demande pour la sécurité systémique va s'accroître à la suite de l'accident de Challenger, mais la sécurité systémique apparaît maintenant comme incapable de réaliser ses promesses, l'élimination des accidents. En fait, le

désir inhérent à la sécurité systémique, de l'importance des relations sociales dans la gestion des relations entre les travailleurs et leur travail, introduit de nouveaux problèmes. Des effets pervers telle que l'atteinte du sentiment de vérité et de justice des travailleurs, l'introduction de nouveaux types d'accidents, l'inégalité et les effets inefficaces des investissements, apparaissent à nouveau sur la scène.

Beaucoup de processus modernes de haute technologie sont conçus de telle façon qu'ils sont si complexes, si pleins d'inconnus et si étroitement connectés à la fois sur le plan fonctionnel et sur le plan temporel [comme le montre Perrow], que les travailleurs sont incapables d'acquérir les qualifications nécessaires pour exécuter le travail avec sûreté, et la direction est incapable de coordonner le travail de façon à prévenir des phénomènes étendus de désorganisation. La conception du processus de travail a rendu impossible aux travailleurs la construction de notions adéquates relatives à l'état du processus et au contrôle de danger pour bâtir un modèle de "vérité".

Le rapport Rasmussen de 1975 est un élément central de référence pour l'école systémique de sécurité et est utilisé fréquemment par ceux qui cherchent à vendre l'idée : les accidents de centrales nucléaires sont des situations proches de l'impossible. La Commission de Contrôle Nucléaire (Nuclear Regulatory Commission) des U.S.A. s'est montrée critique vis-à-vis de ce rapport du fait du traitement simpliste qu'il accorde aux accidents systémiques, types d'accidents propres aux systèmes complexes. Ce type d'accident que nous examinerons empiriquement apparaît comme largement ignoré par la littérature de sûreté systémique. Cela a conduit E.W. Hagen, un des directeurs du journal Nuclear Safety à observer que les spécialistes des accidents travaillent activement dans un domaine dont on n'a pas montré qu'il constituait le problème principal, ce dernier étant la complexité de ces systèmes en elle-même.

Charles Perrow fait une distinction entre les défaillances des composants et les accidents systémiques. Ces deux types d'accidents commencent par des défaillances d'instrument, mais dans les accidents systémiques, les défaillances multiples interagissent selon des modalités qui n'ont pas été prévues par les ingénieurs système et par ceux qui ont été formés à les utiliser, alors que dans les cas de défaillance de composants, les phénomènes peuvent être anticipés et compris ....

CONCLUSION

p. 268 - Toutes les industries considérées du point de vue de la sécurité systémique ont au moins un point commun : quand les travailleurs développent un sens de la vérité et connaissent les dangers de leur travail, ils peuvent décider de les accepter ou de les refuser. Ces industries peuvent différer selon deux aspects importants : d'abord, il peut se révéler impossible pour les travailleurs de développer une notion de vérité, et par ailleurs, les accidents peuvent inclure une exposition du public à de graves périls ...

... L'élite technocratique parle comme si elle, et elle seule, était l'incarnation de la raison et du progrès. Elle ignore les recommandations politiques du type de celles de Perrow, et se moque des conceptions populaires de vérité et de justice, des craintes de désastre et des demandes pour des contrôles socialement transparents des technologies. L'opposition montre le coût élevé - économique, politique et social - du développement technocratique de certains processus industriels et en faisant cela, a été capable de ralentir la réalisation de certains projets technocratiques ...

Des mouvements sociaux peuvent contraindre à l'abandon de l'énergie nucléaire, symbole de l'âge technocratique. Cependant, un tel abandon ne pourrait être considéré comme le signe d'une blessure mortelle du pouvoir technocratique. Ce dernier continuera à pénétrer toutes les sphères de la vie de diverses façons et un des modes de pénétration au poste de travail sera la sécurité systémique ... Inutile de dire que la plupart des spécialistes de la sécurité associés à cette école [systémique] continueront à exclure toute notion de production sociale des accidents ...

p. 270 - L'approfondissement de l'approche réglementaire, en particulier grâce à des règlements d'origine gouvernementale, représente une continuation de la solution weberienne à la notion marxiste du conflit de classe que les accidents industriels ont aidé à rendre visible. Le développement de l'école des coûts-bénéfices est une réponse au coût croissant de la solution weberienne du point de vue économique et social. Cette école cherche une solution dominée par la rationalité de l'économie du marché. L'école systémique - sous sa forme pure - cherche à construire une rationalité sociale qui dépasse les conflits économiques et politiques qui sous-tendent les autres approches, bien que son projet de planification et de programmation totales du processus de travail cherche à faire naître une orientation culturelle favorable à cette entreprise.

Nous avons vu que chacune de ces écoles a rencontré des impasses dans sa capacité de prévenir les accidents, ce qui soulève des questions sur la possibilité de changements. Au début des années 70 [une façon pudique de parler des événements de 1968 considérés par l'auteur comme la rupture], compte tenu de l'existence générale de forces de rupture, les perspectives politiques paraissaient favorables à l'émergence de changements fondamentaux ... En fait, ces forces demandant, par ailleurs, une plus grande participation des travailleurs, semblent avoir eu plus de succès pour obtenir une rigidification et une réorganisation de l'approche normative ...

p. 271 - VERS UNE NOUVELLE ECOLE

La vaste majorité des militants des mouvements sociaux se sont incorporés dans les 3 écoles. Ce qui, au début des années 1970, apparaissait comme une base politique potentielle pour une nouvelle école, est beaucoup moins net aujourd'hui ...

p. 275 - LE REAJUSTEMENT DU PRISME : LA REUNION DES FORCES POLITIQUES ET DES BASES INTELLECTUELLES ...

ELEMENTS DE LA SCENE POLITIQUE ...

EMPLOYEURS ...

... Dans "au-delà de la mécanisation", Hirschhorn a consacré un effort considérable à l'examen des équipes autonomes. En pensant à Three Miles Islands et à d'autres accidents sur des réacteurs nucléaires, il montre que "nous devons concevoir les situations de travail de telle sorte que les travailleurs puissent effectivement utiliser er les commandes, les modifier et les règler pour prévenir les défaillances et les erreurs que l'ingénieur n'avait pas anticipées". Il propose que, dans les systèmes, les travailleurs soient en état de constituer une vision cohérente de ce qui se passe dans leur domaine, et qu'ils aient la capacité de la corriger. Ces travailleurs doivent être en état de "comprendre les conséquences de leurs décisions de contrôle". Il développe encore son argument les nouvelles technologies exigent que nous développions une culture de l'apprentissage, une appréciation des phénomènes qui apparaissent et la compréhension du savoir tacite, un sens des relations intersubjectives et une appréciation de nos choix de conceptions organisationnelles".

Ce que Hirschhorn appelle "travail post-industriel" est géré avec succès quand les travailleurs ont la capacité de développer leurs propres notions de vérité et d'agir selon elles ...
Après avoir considéré les activités industrielles classiques en Suède, une discussion montre que la qualité de la vie de travail peut être améliorée quand les travailleurs assistent la direction dans les décisions d'investissement ...

p. 276 - UN INTERMEDE : L'EDUCATION A LA SECURITE ET LA NOTION DE VERITE CHEZ LES TRAVAILLEURS ...

... Dans quelles limites est-ce que l'idée que les travailleurs peuvent être éduqués à la sécurité contredit l'idée centrale dans ce livre - selon laquelle les travailleurs ont un sens de la vérité et de la justice qui les guide dans l'exécution de leur travail, et que, quand ils sont orientés vers une façon sûre d'agir, et qu'ils peuvent agir de façon autonome par rapport à la domination des forces sociales à d'autres niveaux, ils construisent une situation de travail sûre. La vérité est - nous l'avons vu - une notion qui se forme expérimentalement dans un contexte social; associée avec le sens de la justice, elle constitue une fondation d'une tradition culturelle. Dans les périodes de changement rapide, quand l'expérience d'un processus ou d'un matériau est faible, les chances des travailleurs d'obtenir un savoir fonctionnellement convenable sont réduites ...

p. 277 - ... Les relations sociales imprègnent la construction de la représentation de la sécurité chez les travailleurs. Par exemple, les travailleurs peuvent rejeter des dispositifs de protection qu'ils considèrent comme injustes, et créer alors de fausses notions de causalité qu'ils construisent comme ayant une valeur de vérité rationalisant ainsi leur rejet. [Avec une telle dialectique, on peut manipuler la notion de vérité et de justice chez les travailleurs au-delà du raisonnable] ... Pour que les explications causales puissent être considérées comme adéquates, il faut, dans la perspective développée dans ce livre, qu'elles soient confirmées en référence avec le système de signification des travailleurs. Ce processus éducatif "de haut en bas" est inversé par la logique de quelques études récentes où, au lieu d'accepter les définitions des causes de risque données par les professionnels, les chercheurs ont trouvé des données significatives grâce à des entretiens avec les travailleurs. Les résultats obtenus ainsi conduisent à la construction d'hypothèses causales ...

Les programmes "d'éducation" reposent souvent sur l'idée qu'il existe une seule vérité et sont considérés comme efficaces quand cette "vérité" est acceptée par les travailleurs. Un tel succès ne représente souvent rien d'autre que la soumission idéologique des salariés aux perspectives de la direction. Une telle conception est violemment opposée du point de vue adopté dans ce livre ...

p. 282 - ... Une telle évaluation conduit à une conclusion assez pessimiste au sujet des bases politiques possibles pour une école sociologique qui se trouve ainsi sur un terrain fragile. Ces bases sociales ont été désagrégées par un double processus grâce à la combinaison de la répression par le capital et les bureaucraties publiques et grâce à l'intégration dans les autres écoles où se trouvent la production et la transmission du savoir. Dans les comités et les représentations des travailleurs dans les situations de travail, c'est la paralysie scandaleuse du mouvement syndical qui est en cause [Ce genre d'appréciation ne me paraît ni scientifique, ni en particulier sociologique, mais politique et militant. En effet, la question scientifique-sociologique est celle de savoir pourquoi les syndicats sont paralysés dans ce domaine. Dwyer devrait réfléchir à la question fondamentale dans son domaine, du pouvoir dans les organisations et du changement des forces sociales depuis 1988 du fait de la transformation politique et économique du monde] ...

p. 284 - Ceux qui ont une expérience sociale des accidents, les voit traités en termes matériels. Ceux qui regardent les accidents à partir de conception de vérité et de justice sont considérés comme évoquant des valeurs par ceux qui affirment traiter la sécurité en accord avec les "faits". Le problème des relations sociales a été transformé en un problème que l'on peut résoudre par la négociation et l'administration. Mais une telle transformation a produit un vide entre travailleurs et syndicats. Une des conséquences de ce vide est la rupture : les travailleurs se heurtent non seulement aux hiérarchies syndicales en voulant une priorité plus forte pour la sécurité, mais aussi contre les approches actuelles de la sécurité - approches formulées activement ou passivement avec le soutien syndical.

p. 284 - UNE ECOLE NOUVELLE ET SOCIOLOGIQUE : REGARD FINAL ...

... Quand la majorité des accidents est produite par des primes de rendement, le rôle des interventions "techniques" est faible. Certaines formes de désorganisation et de sous-qualification peuvent émaner de l'incapacité de certaines structures des tâches à tenir compte des limites des performances humaines; dans de tels cas, les disciplines

comme l'ergonomie, la psychologie cognitive et la médecine peuvent chacune jouer un rôle analytique. De nouveaux instruments légaux peuvent distinguer les différents types de relations sociales. Par exemple, la production délibérée par les employeurs de la sous-qualification des travailleurs, doit être distinguée de l'offre habituelle de récompenses financières quand un procès a lieu pour prévenir ou punir la production d'accidents ... Le système judiciaire peut développer de nouveaux critères pour évaluer la responsabilité de l'employeur et des salariés dans la production d'accidents : les accidents produits par l'autoritarisme doivent être soumis à la législation criminelle, ceux qui sont produits par la routine à la législation pénale ...

"LE PUBLIC" : UN NOUVEL ACTEUR POLITIQUE ENTRE EN SCENE ...

p. 287 ... D'un point de vue sociologique, le "public" apparaît comme une catégorie trop nébuleuse pour être considéré comme un acteur social capable d'influencer les politiques de sûreté. Nous avons vu qu'il existait aux Etats-Unis un public qui résiste à certains types de développement parce qu'il éprouve une "terreur du risque". Cet effet est produit chez les gens qui se sentent soumis à des risques croissants, inconnus, inhabituels, incontrôlables, susceptibles de produire un grand nombre de morts et répartis inégalement. L'accroissement de la terreur du risque a été interprétée comme une réaction à la croissance du pouvoir technocratique, pouvoir lié à la sécurité systémique. Ceux qui éprouvent la terreur du risque sont considérés comme un segment d'un acteur, en préparation dans le domaine anti-technocratique, un acteur qui cherche à construire un pouvoir démocratique suffisamment fort pour se confronter avec un adversaire qui construit son pouvoir sur la base du savoir, renforcé par les outils de la complexité et du secret, un pouvoir qui cherche à soumettre tous les aspects de la consommation et de la production à ses plans.

[Et si la terreur du nucléaire était favorisée ou produite par les compagnies pétrolières qui n'aiment pas que l'on évoque l'énorme quantité de morts liée à la possession et au prix du pétrole (guerre d'Algérie, Liban, conflit irano-irakien, guerre du Koweit) ?].

DWYER T. (1991) Life and death at work. Industrial accidents as a case of socially produced error PLENUM pub NEW-YORK, 318 p.

Analyse à paraître dans le Travail Humain

Tom Dwyer est un sociologue néo-zélandais, d'origine irlandaise, qui, après des recherches sur le terrain en Nouvelle-Zélande et en France dans le domaine des accidents du travail dans le bâtiment, a soutenu sa thèse en France sur la genèse des accidents du travail, et enseigne maintenant à l'Université de Campinas au Brésil. Dans "Life and death at work", Tom Dwyer reprend et structure l'ensemble de ses travaux tous orientés vers l'analyse des accidents du travail considérés d'un point de vue sociologique.

Le livre de Tom Dwyer bénéficie d'une documentation considérable. Plus de 700 notes réfèrent à des travaux d'autres auteurs qui sont plus ou moins longuement commentés. L'usage que le lecteur peut faire de cette remarquable bibliographie est toutefois rendu quelque peu malaisé du fait de l'absence d'une liste alphabétique des auteurs cités en référence.

La documentation ainsi réunie par l'auteur lui permet de tracer un historique de la représentation des accidents du travail et de la lutte contre ceux-ci. Il décrit cette histoire comme une suite de crises séparées par des paliers où les solutions élaborées par la société à la suite des crises demeurent acceptées.

Après une période pré-industrielle où l'accident apparaît comme le résultat d'un mauvais sort ou des péchés de l'humanité, la croissance rapide de la fréquence des accidents bien étudiée dans les mines de charbon britanniques au début du XIXe siècle, conduit à la création de la prévention technique réglementaire. Pour Tom Dwyer "l'approfondissement de l'approche réglementaire, en particulier grâce à des règlements d'origine gouvernementale représente une continuation de la solution weberienne à la notion marxiste de conflit de classe que les accidents du travail ont aidé à rendre visible. Le développement de l'école des coûts-bénéfices en matière de sécurité du travail est à son tour une réponse au coût croissant de la solution weberienne du point de vue économique et social; l'école coût-bénéfices cherche à construire une solution dominée par la rationalité de l'économie de marché. L'école

systémique - sous sa forme pure - cherche à construire une rationalité sociale qui dépasse les conflits économiques et politiques qui sous-tendent les autres approches. Son projet de planification et de programmation totales du processus de travail, tend à faire naître une orientation culturelle favorable à cette entreprise". Les recherches ergonomiques et psychologiques sur la fiabilité humaine dont le rapport Rasmussen (1975) est le texte le plus connu, font partie intégrante de l'approche systémique.

Dans chaque institution de prévention, les 3 écoles réglementaire, coûts-bénéfices et systémique se trouvent représentées, mais elles ne satisfont ni les travailleurs ni les public. Chacune des écoles a conduit à des impasses dans sa capacité de prévenir les accidents ce qui soulève des questions sur les possibilités de changement. Au début des années 70 [une façon pudique pour Tom Dwyer d'évoquer les événements de 1968 considérés par l'auteur comme la rupture], compte tenu de l'existence générale des forces de rupture, les perspectives politiques apparaissaient favorables à l'émergence de changements fondamentaux. En fait, ces forces demandant par ailleurs, une plus grande participation des travailleurs, semblent avoir eu plus de succès pour obtenir une rigidification et une réorganisation de l'approche normative.

Pour faire réussir l'école sociologique des accidents du travail que Tom Dwyer a créée et veut développer, l'apparition du "public" dans le champ des accidents est essentielle. Il existe, en particulier aux Etats-Unis, un "public" qui résiste à certains types de développements techniques parce qu'il éprouve une "terreur du risque". Cet effet se produit quand les personnes se sentent exposées à des risques croissants, inconnus, inhabituels, incontrôlables et susceptibles de produire un grand nombre de morts. L'accroissement de la "terreur du risque" peut être interprétée comme une réaction à la croissance du pouvoir technocratique, pouvoir lié à la sécurité systémique, et dont l'arrogance se trouve contredite par les catastrophes des dernières années.

L'école sociologique comporte pour Tom Dwyer 4 hypothèses principales :

1) Les relations sociales au travail produisent des accidents du travail.
2) Plus lourd est le poids d'un certain niveau des relations sociales dans la gestion des relations des travailleurs avec les dangers de leur travail, plus grande est la proportion d'accidents produits à ce niveau.

3) Plus fort est le niveau d'auto-contrôle par les travailleurs à un niveau donné, plus faible est la proportion d'accidents produits au niveau que l'action des travailleurs peut contrôler.
4) Plus grand est le degré de gestion de la sécurité par la direction à un niveau donné, plus basse est la proportion d'accidents produits au niveau que la direction tend à contrôler.

Quelle que soit la valeur de ces hypothèses précises, tout chercheur, tout observateur qui a étudié le travail sur le terrain sait combien les forces sociales distordent dans la réalité les règles que chacune des 3 écoles antérieures ont émises. La nécessité d'une approche sociologique de la constitution du risque à tous les niveaux de la conception, de l'organisation et de la gestion du travail, nous paraît donc réelle, et le livre de Tom Dwyer apporte une contribution significative à cette approche.

Un autre élément essentiel de la pensée de Tom Dwyer est l'existence chez les travailleurs d'un "sentiment de vérité et de justice". Cette affirmation de l'auteur correspond au retour très intéressant de la morale sous la forme de l'éthique dans les réflexions actuelles sur la société. Ceux qui sont attachés à l'analyse ergonomique du travail, c'est-à-dire à la description du travail réel, ne peuvent qu'apprécier les concepts de vérité et de justice tels que Tom Dwyer les évoque, mais il faudrait établir des règles précises pour que le franchissement des limites de l'observation objective ne conduise pas à une manipulation sociale des valeurs que Tom Dwyer invoque. Il n'y a, par contre, pas de danger si l'on suit avec les ergonomistes, les recommandations de Hirschhorn cité par Dwyer. "Dans les systèmes qu'ils utilisent, les travailleurs doivent être en état de constituer une vision cohérente de ce qui se passe et de corriger le fonctionnement du système. Ces travailleurs doivent être en état de comprendre les conséquences de leurs décisions de contrôle".

La réflexion de Tom Dwyer sur le sentiment de vérité et de justice prend toute sa valeur quand l'auteur aborde la formation à la sécurité. "La vérité est une notion qui se forme expérimentalement dans un contexte social; associée avec le sens de la justice, elle constitue une fondation d'une tradition culturelle. Mais, dans les périodes de changement rapide, quand l'expérience d'un processus ou d'un matériau est faible, les chances des travailleurs de constituer un savoir fonctionnellement convenables sont réduites ..."

Les thèmes qui viennent d'être évoqués brièvement sont loin de constituer le seul contenu de ce livre d'une grande richesse, fruit d'une culture très vaste qui va de l'histoire de l'invention et de l'usage de la lampe Davy en 1816, à l'évolution du sentiment de la mort dans le monde moderne comme le montre Philippe Aries. Ce qui est très rare dans un livre appartenant à la littérature anglo-américaine, c'est de trouver autant de rapprochements judicieux entre auteurs de langue anglaise et auteurs français (Crozier, Faverge, Touraine, Quinot, Queré, Cottereau, Lenoir, Valentin, Dejours, Laville, Montmollin, Roustang, Mottez, Leplat, Cuny, etc ...). On peut avoir ainsi une image très intéressante des convergences et divergences des modes de pensée qui sont les nôtres avec la littérature de langue anglaise.

La lecture attentive du livre complexe de Tom Dwyer est d'une grande utilité, non seulement pour les sociologues du travail ou les spécialistes de la sécurité du travail, mais pour tous ceux qui cherchent à comprendre où se situent le ou les fils de leurs recherches et de leurs pratiques dans le tissu multicolore du travail pour emprunter à Tom Dwyer l'une de ses métaphores.

A. Wisner

******* MATRACOM ********** JOURNAL ********** DATE 26-02-1993 ***** HEURE 14:25 ********

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Destinataire : Pr. TOM DWYER
To :

N° Télécopieur : 19.55.192.39.38.27

Objet :
Message :

Emetteur :
From :

M Pr Wisner

Laboratoire d'Ergonomie
Conservatoire National des Arts et Métiers
41, rue Gay-Lussac
75005 PARIS
FRANCE

Téléphone [33] 1 44 10 78 12
Phone

Secrétariat [33] 1 43 54 18 27
Secretary

Télécopieur **[33] 1 43 25 36 14**
Fax number

Paris, le 22 Février 1993

Monsieur le Professeur Tom Dwyer
The Graduate School and University Center
of The City University of New-York
33 West 42 Street
NEW-YORK, N.Y.
(U.S.A.)

Cher Tom,

J'ai reçu avec plaisir votre lettre du 8 Février où j'ai senti que votre activité était toujours aussi forte et votre travail passionnant.

Je souhaite d'abord vous rassurer sur l'analyse de votre livre dans le Travail Humain. Je me suis aperçu que personne n'en était chargé. Je sais, par ailleurs, qu'il est impossible de demander le moindre travail supplémentaire à Christophe Dejours qui est épuisé par d'énormes activités d'enseignement et de recherche; il ne peut lire et écrire que pour cela. Comme, par ailleurs, j'ai beaucoup travaillé sur l'organisation du travail, j'ai demandé au Travail Humain de me confier l'analyse de votre livre. Je suis donc en train de le lire à cet effet. Ce n'est pas une tâche facile puisque je ne suis pas un sociologue, et que je ne voudrais pas que mon analyse, tout en restant bienveillante, soit aussi marquée par l'incompréhension que celle de "Accident, analysis and prevention".

Il est vrai que vous ne guidez pas le critique,car vos hypothèses fondamentales sont situées assez loin dans le texte au cours d'un chapitre, et qu'à la fin, il n'y a pas de conclusion qui résume vos opinions sur la façon dont vous avez - ou non - confirmé vos hypothèses. Mais l'essentiel n'est pas là. Vous montrez fortement que la folie des préventions techniques et réglementaires aboutissent à des impasses dramatiques du fait de la négligence volontaire et systématique de la vie sociale industrielle. En ce sens, il est parfaitement vrai que vous montrez la protection sociale des accidents. Etant donné la persistance de mon orientation anthropologique, je regrette que vous ayez abandonné dans ce livre le point de vue comparatiste.

En effet, nos sociétés industrielles diffèrent beaucoup les unes des autres. Je suis frappé, en particulier, par la persistance au Brésil, en Thaïlande et aux Philippines, comme en Algérie et en Tunisie, d'un patronat pré-industriel.

Je vous adresse, ci-joint, le texte anglais d'un article que j'ai préparé à la demande de la Revue Sociologia del Trabajo. Cet article paraîtra en espagnol. Vous

trouverez également le texte d'une communication que j'ai faite à Sao Paulo pour l'Instituto de Estudios Advançadas.

Je vais séjourner au Brésil pendant le mois de Mai, mais contrairement à mon projet initial, je n'y resterai qu'un mois, et seulement à Rio pour travailler à la COPPE. Il me faut, en effet, réduire quelque peu mes activités à cause de mon âge et de mes problèmes familiaux.

Je serai d'ailleurs à la retraite le 30 Septembre 1993, mais serai nommé à cette date Professeur Emerite pour 3 ans. Cela veut dire que j'aurai la possibilité de continuer à diriger des thèses (j'en ai une quinzaine encore en chantier) et à accomplir des missions officielles. Si je suis assez en forme, je reviendrai au Brésil en 1994 pour consacrer l'essentiel de mon temps à Sao Paulo où l'ergonomie est à la fois prospère et très dispersée, ce qui rend mon travail de consultant difficile. Je pourrais éventuellement aller vous voir à Campinas si vous le souhaitez.

J'ai noté avec plaisir votre intention de venir en France en 1993/1994, mais je suis assez dépourvu pour vous aider : d'une part, je n'aurai plus de poste officiel dans 6 mois, et d'autre part, les personnes que vous pourriez intéresser me paraissent indisponibles ou nommées trop récemment à leur poste.

Je vais pourtant essayer quelques démarches auprès de l'Agence Nationale pour l'Amélioration des Conditions de Travail (ANACT), du Centre d'Etudes et de Recherche sur les Qualifications (CEREQ), car les Directeurs me paraissent proches de vos positions, mais ils auront peut-être peur, dans les conditions politiques qui vont prévaloir, de présenter des vues sur les accidents du travail qui attaquent trop fortement les positions officielles ...

J'essaierai aussi de vous mettre en contact avec Gilbert de Terssac, car c'est un sociologue et un ergonomiste très ouvert.

Tout cela n'est pas facile car les conditions de travail n'intéresse pas l'Intelligentsia française trop secouée par le choc du mark.

Je voudrais être avec vous à New-York car je suis fasciné par cette ville merveilleuse et horrible ...

Bon courage pour votre oeuvre courageuse et constructive.

Bien amicalement.

A. Wisner

The Graduate School and University Center
of The City University of New York

Ph.D. Program in Sociology / Box 375
Graduate Center, 33 West 42 Street, New York, N.Y. 10036-8099
212 642-2401

ETATS UNIS

M. le Professeur Alain Wisner,
CNAM,
41 rue Gay-Lussac
75005 Paris,
France

8.II.93

Cher Alain Wisner,

je vous écris de New York où je continue mes recherches sur l'interdisciplinarité et où je profite bien de cette ville merveilleuse. Les Etats Unis, avec l'élection de Clinton et Gore, vient d'embarquer dans ce que la plupart des intellectuels que j'ai recontrée décrivent comme étant de "l'inconnu". Néanmoins ce même monde est très content que la longue période des gouvernements républicains est terminée et personne ne cache des éspoirs qu'une nouvelle époque va s'ouvrir. C'est fascinant!

J'ai été très content de vous revoir en pleine forme à São Paulo l'année dernière. Et j'espère que le reste de cet année s'est bien passé. Lors de nos discussions vous avez manifesté un désir d'aller à Campinas et je voudrais bien voir votre disponibilité quant à un possible voyage. Comme je travaille en sciences sociales je ne pourrais point être la principale personne à assurer le patronage de votre séjour, il faudrait que ce soit un professeur d'une autre unité (je pense à Iguti). Je pourrais toutefois organiser l'appui officiel de mon unité à votre eventuel séjour.

L'autre jour j'avais déjeuné avec mon éditeur et il m'a demandé des informations quant à l'état des comptes rendus du livre. En ce moment je continue de les attendre avec une certaine impatience. (Que je sache une demie douzaine sont en train d'être publiés ou écrits, et qu'il n'en est sorti que deux. Le compte rendu dans Accident Analysis and Prevention a été favorable mais l'auteur n'avait pas compris le livre! L'autre, et comme vous pouvez imaginer sur le plan intellectuel ce sont les comptes rendues françaises qui m'importent le plus, devrait vous plaire, il a été publié en octobre dans La revue française de sociologie). Lors de votre visite à São Paulo je vous ai demandé de vous renseigner auprès de la revue Le Travail humain sur la possibilité d'un compte rendu de mon livre. Je vous rappelle que j'en avais fait envoyer un exemplaire à la revue en l'adressant à Christophe Déjours en tant que membre du conseil de rédaction. Je vous écris pour que je puisse avoir des conditions de fournir une réponse à l'interrogation de mon éditeur sur Le Travail humain.

Le dernier point de cette lettre est que je vais essayer de venir en France cette année et je commence à investiger les possibilités de donner des cours ou de trouver d'autres moyens de appui financier. Je sais que vous allez prendre votre retraite et que les choses au CNAM doivent changer- mais je voudrais vous demander les conseils sur où je dois chercher pour essayer de réaliser ce but. Pour vous aider dans votre réflection j'ai pris la liberté de vous envoyer un exemplaire de mon curriculum (mais je vous prie d'excuser les erreurs de français).

Je vais vous expliquer quels sont mes projets pour l'année de 1993. Je dois donner mes cours à Campinas jusqu'à la fin du mois de juin. Ensuite, je devrais voyager pour donner des cours et faire des recherches en Océanie pendant les mois de juillet à octobre, et je n'ai aucune obligation au Brésil jusqu'au mois de mars de 1994. Donc je suis disponible pour un séjour en France entre le commencement de novembre de 1993 et la fin février de 1994 (mais je ne compte pas passer toute cette période en France). Quant à mes possibles activités: je pourrais donner un cours de troisième cycle allant jusqu'à une trentaine d'heures sur une sociologie des accidents du travail (utilisant mon

livre comme base), ou je pourrais faire autrechose- ici mon curriculum vous donnera une idée de ce que je pourrais faire.

J'ai écris à une collègue à l'INSERM (Annie Thébaud-Mony), et hors de Paris je viens de recevoir une lettre de Jean Philippe Hesse de la Faculté de droit et de sciences politiques à l'Université de Nantes (qui édite la revue, qui d'ailleurs ne sort plus depuis longtemps, Histoire des accidents du travail) où il discute les possibilités d'un séjour dans sa université. Je me tourne maintenant vers vous.

Je sais que vous êtes surchargés de demandes qui vous arrivent de tous les coins du globe, et j'ai hesité avant d'ajouter ma contribution. J'espère que vous auriez la possibilité de me donner une réponse quant à votre disponibilité pour aller à Campinas en m'écrivant au mois de mars à Campinas. Je souhaite pouvoir donner une réponse à mon éditeur sur la question du compte rendu- si possible avant de quitter les Etats Unis (le numéro de télécopie ici c'est le 212-642-24-19).

J'espère que cette lettre vous trouve en pleine santé,

bien amicalement,

Tom Dwyer

Visiting Scholar

1 décembre de 1992

Curriculum Vitae

Nom: Tom (Thomas Patrick) Dwyer
Nationalité Néo zélandaise et irlandaise, avec un visa de résidence permante au Brésil.
Date de naissance: 19 juin de 1952.

Poste universitaire: Professeur , Instituto de Filosofia e Ciências Humanas, Universidade Estadual de Campinas, São Paulo, Brésil. (depuis 1984).

Poste administratif universitaire: Coordenateur du Programme Travail et syndicalisme du doctorat en sciences sociales, Universidade Estadual de Campinas. (depuis septembre de 1991).

Adresse universitaire: IFCH/DCP,
Caixa Postal 6110,
13081 Campinas, S.P.,
Brazil

Adresse résidentielle: R. Haddock Lobo, 547, apto. 71
01414 - São Paulo
Brésil

Numero de téléphone résidentiel: 55 (11) 257-46-38
Télécopie (fax): 55-192-39-33-27
Bitnet: Tom@CCVAX.UNICAMP.ANSP.BR.

Qualifications universitaires

1978. Doctorat du Troisième Cycle (sociologie), L'Ecole des Hautes Etudes en Sciences Sociales, Paris, France. (Directeur de thèse M. Alain Touraine).

1975. B.A. (Hons) (sociologie), Victoria University of Wellington, Nouvelle Zélande.

1973. B.A. (sociologie et administration), Victoria University of Wellington, Nouvelle Zélande.

Expérience universitaire

1982-83. Post-doctoral Fellow in Sociology, University of Canterbury, Nouvelle Zélande.

1976. Tutor (premier semestre), Department of Sociology, Australian National University, S G.S., Canberra.

1975. Tutor, (mi-temps), Department of Sociology, Victoria University of Wellington.

Nomination aux postes visitantes en universités

1991-92. Visiting Scholar. Sociology Department, Graduate Center, City University of New York. Etats Unis, décembre- février.

1990. Visiting Fellow. Science, Technology and Society Program, Cornell University, N.Y., Etats Unis. janvier-décembre.

1989. Chercheur Visitant. IRIS-TS, Université de Paris- Dauphine/ CNRS, Paris, France. octobre-novembre.

1987. Visitor. Department of Sociology, Canterbury University, Christchurch, Nouvelle Zélande, juillet-août.

1987. Visiting Lecturer. Department of Sociology, Massey University, Palmerston North, Nouvelle Zélande, juillet-août.

1986. Maître des Conferences. Laboratoire d'Ergonomie et Neurophysiologie du Travail- doctorat en ergonomie, Centre National des Arts et Metiers (CNAM), Paris, France. janvier-février.

Bourses d'études

1991-92. Bourse d'études post-doctorales de la FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) pour un voyage à New York pour faire des recherches bibliographiques sur l'interdisciplinarité dans les études de travail.

1991 (avril 1991- avril 1993) Bourse d'études du Conselho Nacional de Pesquisa Científico, (CNPq) pour conclure un livre sur les accidents du travail au Brésil.

1990. Bourse d'études post-doctorales du Conselho Nacional de Pesquisa Científico, pour un voyage à Science Technology and Society Program, Cornell University, EUA, pour faire des recherches bibliographiques sur l'interdisciplinarité dans les études de travail. janvier-décembre.

1989. Bourse d'études dans le cardre d'un acord bi-lateral CAPES (Brésil)- COFECUB (France) pour être nomé chercheur invité, IRIS-TS, CNRS, Université de Paris- Dauphine, pour pouvoir investiger les nouvelles technologies et la transformation du travail. Octobre-novembre.

1985-86. Bourse d'études post-doctorales de la FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) pour un voyage en Grande Bretagne et en France pour faire des recherches sur les nouvelles technologies de télécommunications et les accidents du travail et pour être professeur visitant au Laboratoire d'Ergonomie et Neurophysiologie du Travail, CNAM, Paris.

1982. Stagaire ACTIM. (Agence du gouvernement français pour la coopération technique), Paris. Investigation des nouvelles technologies de téléciommunications. mars-avril.

1976-78. Bourse du Gouvernment Français, Pour les études de doctorat.

Prix

1992. Bolsa Prêmio Zeferino Vaz de l'Universidade Estadual de Campinas.

Membre d'associations scientifiques

1992-94. Coordinateur national du groupe de travail Processo de Trabalho e Reivindicações Sociais (Procès du travail et révindications sociales) de l'Associação Nacional de Pós-Graduação e Pesquisa em Ciências Sociais (ANPOCS).

1991-94. Coordinateur dans l'état de São Paulo du groupe de travail Processo de Trabalho e Reivindicações Sociais (Procès du travail et révindications sociales) de l'Associação Nacional de Pós-Graduação e Pesquisa em Ciências Sociais (ANPOCS).

1984- membre du groupe de travail Processo de Trabalho e Reivindicações Sociais, ANPOCS..

1981-82, 1983-85- membre de la Sociological Association of Australia and New Zealand.

1982-84. membre de la Association of Social Science Researchers (ASSR), Nouvelle Zélande.

1980-82. Coordinateur à la fondation de l'Association of Social Science Researchers (ASSR), Nouvelle Zélande.

Publications

Publications principales

1991 - Life and Death at Work: industrial accidents as a case of socially produced error. New York, Plenum. (p. 317 + xv)

1983 - The Industrial Accident Data Base. Wellington, Department of Labour et l'Accident Compensation Commission. (p. 195)

1981 - Industrial Accidents and Nightwork in the Manufacturing Sector. Department of Labour, Research and Planning Division, Wellington. (p. 117 + iii)

1978 - Une Conception sociologique des accidents du Travail. Doctoral Thesis, Ecole des Hautes Etudes en Sciences Sociales, Paris. (décembre). (p. 342 + v)

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1988. New Challenges for Ergonomics. Ergonomics New Zealand. 3 (4).

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Entretien

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Du péché à la paix sociale: les origines du traitement contemporain des accidents du travail dans les sociétés industrielles. Histoire des accidents du travail, no. 20.

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Double remis à A. Weill-Fassina

avec un cartan et le texte complet

Paris, le 5 Mars 1993

Madame Marion Chesnais
Université Paris VIII
Equipe de Psychologie cognitive
et Ergonomique
2 rue de la Liberté
93526 Saint Denis

Chère amie,

Annie Weill-Fassina, à qui je faisais part du souhait de Tom Dwyer de voir son livre analysé dans le Travail Humain, et à qui je précisais que j'étais disposé à faire cette analyse, a bien voulu prendre contact avec vous. Je vous remercie d'avoir donné une réponse favorable à cette demande.

Vous trouverez, ci-joint, mon texte. Je suis tout à fait disposé à le modifier au cas où cela serait souhaitable.

Veuillez agréer, chère amie, l'expression de mes sentiments dévoués.

A. Wisner

Paris, le 4 Mars 1993

Professeur Tom Dwyer
Rua Haddock Lovo 547
Apto 71
01414 Sao Paulo Brésil

Cher Tom,

Je vous remercie de m'avoir donné l'occasion de lire plus attentivement votre remarquable livre, comme je vous l'avais promis dans ma lettre du 22 Février.

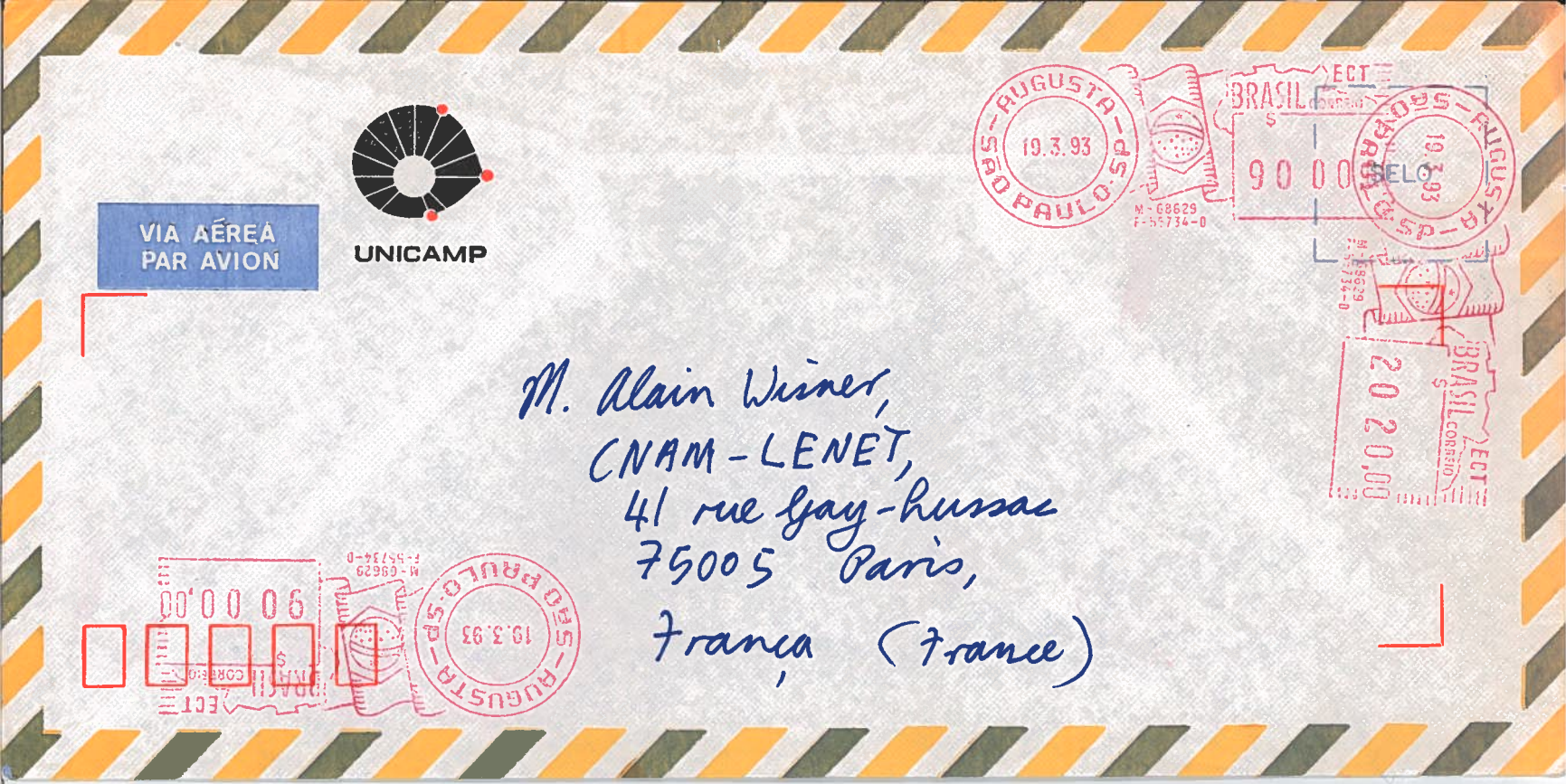
J'ai écrit une analyse qui paraîtra dans le Travail Humain, mais peut-être pas dans le prochain numéro. Je serais curieux de savoir si j'évoque bien ce qui vous préoccupe ou si je suis passé, comme les autres, à côté de vos idées essentielles. Ma façon habituelle de travailler sur un livre en anglais est d'en traduire des passages et d'y ajouter, entre crochets, quelques remarques parfois assez vives.

L'ensemble de ces fiches (il y en a maintenant 500 pages) constitue une bonne partie du matériel sur lequel je donne mon séminaire d'anthropotechnologie et sur lequel les étudiants peuvent travailler. J'ai donc joint ces notes préalables au projet de texte pour le Travail Humain, car j'y exprime plus librement mes réflexions.

Je crois que l'ensemble sera pour nous une matière de discussion passionnée quand nous nous reverrons à Paris ou au Brésil.

Bien amicalement.

A. Wisner


VIA AÉREA
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UNICAMP
M. Alain Weiner,
CNAM-LENET,
41 rue Gay-Lussac
75005 Paris,
França (France)
AUGUSTA-SP
SÃO PAULO-SP
19.3.93
BRASIL
CORREIO
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SELO
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Tom Dwyer
IFCH/DCP

Remetente: UNIVERSIDADE ESTADUAL DE CAMPINAS

Endereço: Cidade Universitária Zeferino Vaz - Distrito de Barão Geraldo
Tel. PABX (0192) 39.1301 - Telex (019) 1150 - Caixa Postal 6110

CEP 1 3 0 8 1 Campinas - SP - Brasil

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M. le Professeur Alain Wisner,
CNAM-LENET,
41 rue Gay-Lussac
75005 Paris,
France

18.III.93

Cher Alain Wisner,

À partir de votre lettre de 22 février que j'ai reçue à la veille de mon départ de New York j'ai eu une enorme satisfaction de savoir que vous alliez faire un compte rendu de mon livre pour le Travail Humain. Cette lettre a été accompagné de deux de vos textes (que, malheureusement, je n'ai pas encore eu le temps d'étudier) et des bonnes nouvelles: que vous viendriez à Rio au mois de mai et que, même si la situation est difficile, vous iriez faire quelques démarches pour voir les possibilités de mon acceuil en France à partir de la fin de cette année.

Quelle surprise agréable j'ai eu en rentrant à São Paulo la semaine dernière de trouver une nouvelle lettre, le compte rendu de Life and Death at Work et des traductions partielles et commentaires du même!

Quand j'ai lu le résultat final de votre long travail je me suis senti au comble de la joie avec l'evaluation très genereuse que vous avez faite du livre. Ensuite j'ai lu votre lettre et les traductions partielles du livre- quand je me suis rendu compte que vos 500 pages (quel effort!!!!) de fiches de lecture constituent "une bonne partie du matériel sur lequel" vous donnez votre "séminaire d'anthropotechnologie et surlequel les étudiants peuvent travailler" je ne croyez pas à mes yeux!

Je suis réellement très content que vous -qui faites un travail dont je suis un grand admirateur- avez donné une telle reconnaissance à ce travail.

Maintenant je commence à penser que toutes ces années passées à travailler presque seul sur ce sujet - un temps que je n'aurais jamais passé sans votre appui et celui d'Alain Touraine- ont valu le coup. C'est drôle que je pensais toujours que avoir écrit un bon livre mais jamais je n'aurais imaginé que le livre aurait le type d'acceuil que vous venez de le donner. L'émotion que je sens, même quelques jours après avoir reçu votre correspondence, reste très grande.

Vous m'avez dit dans votre lettre "Je serais curieux de savoir si j'évoque bien ce qui vous préoccupe ou si je suis passé, comme les autres, à côté de vos idées essentielles." Les notes de lecture que vous m'avez envoyées reproduisent le sens précis de ce que je dis dans

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le livre. Ce que j'ai trouvé genial c'est que votre compte rendu est très sensible aux certaines grandes dimensions du livre et que vous les avez rendues acessibles aux lecteurs non-sociologues. Je trouve toutefois intéressant comment chaque critique du livre apporte ses propres perspectives en analysant le livre; vos préoccupations sur l'éthique, la sécurité systemique et l'ignorance générale des auteurs français par les auteurs anglo-américains sont des choses que personne n'a commenté jusqu'à ce moment et que j'avais toujours pensé importantes. Votre conclusion est aussi très differente de celle d'autres critiques parce que vous poussez le livre dans la direction où il peut être utile à la compréhension d'autres dimensions du travail qui ne soient ni liées aux accidents, ni liées aux erreurs.

Votre analyse du livre s'est basée sur les chapitres 1, 2 et 6. Aussi bien dans les traductions partielles envoyées que dans le compte rendu vous avez laissé la théorie sociologique et l'essai de la tester au deuxième plan. Or, moi-même j'ai fait la même chose l'année dernière -dans l'article apparu dans le Jornal da Tarde et dans les premiers débats sur le livre- ce que m'a valu des fortes rapproches de certains sociologues. Ils auraient tous préféré que je donne priorité aux chapitres 3, 4 et 5. En quelques mots on pourrait dire que dans ces chapitres une théorie sociologique est construite qui conçoit que les accidents du travail sont produits pour relations sociales du travail à trois niveaux -rendement, commandement et organisation. Que la bibliographie classique de la sociologie du travail et les recherches sur les accidents du travail sont utilisées pour donner une base théorique et empirique à cette notion, et que l'auteur essaie de tester quelques hypothèses (que vous citez) derivées de la théorie dans une série d'études conçues de telle manière à être semi-experimentale.

Je dois vous remercier vivement de tous vos efforts de comprendre le livre, je dois dire, de nouveau, que je suis très content avec le type de compréhension que vos avez transmis au Travail Humain et que je suis très heureux avec l'évaluation que vous en faites.

Nos prochaines discussions vont être très intéressantes, j'aurais des remarques à faire sur certains de vos commentaires en paranthèses qui ont accompagné vos traductions et je crois qu'un grand sujet de discussion pourrait-être la liasion entre une approche sociologique et l'anthropotechnologie.

Très amicalement,

Tom Dwyer

Paris, le 1er Octobre 1993

Professeur Tom Dwyer
Rua Haddock Lobo 547
Apto 71
01414 Sao Paulo SP
Brésil

Cher Tom,

Ma note de lecture sur votre livre vient de paraître dans le Travail Humain. Elle vous a procuré au moins un lecteur, Jacques Leplat, mais pas un acheteur car les Professeurs Emérites comme lui et moi n'ont pas de crédits; aussi, lui ai-je prêté mon exemplaire.

Je vous félicite encore et espère avoir l'occasion de reparler avec vous de nos intérêts communs quand je serai pour un mois à Sao Paulo, probablement entre le 15 Avril et le 15 Mai 1994.

Mes correspondants seront, comme d'habitude, Leda Ferreira, Afonso Fleury et Laerte Sznelwar.

Bien amicalement.

A. Wisner

MINISTÈRE DE L'ÉDUCATION NATIONALE
CONSERVATOIRE NATIONAL DES ARTS ET MÉTIERS
ERGONOMIE ET NEUROPHYSIOLOGIE DU TRAVAIL

Paris, le 3rd April 1991

Mr. Tom Dwyer
Rua Haddock Lobo 547, Apto 71
01414 Sao Paulo SP
Brésil

Dear Tom,

I am so sad not to have been able to meet you when we were so closed neighbours in Rua Haddock Lobo. I am always so happy to meet you, full of friendship and humour. I would also have been very happy to know more about your important and excellent researches.

But my stay in Brazil was very short and so loaded that at the end of the day I was exhausted. I am no longer young and I had a lot of former, actual and future students in that country that I was obliged to receive. I had also a lot of teaching. You know that our Brazilian friends are not really reasonable.

Please forgive me. Anyway, I shall be back in Brazil next year at the same period.

May be you will visit Paris in between and why not, at the IEA Congress I organise on 15th-20th July at La Villette ?

With my best regards,

Yours sincerely,

A. Wisner

Encl. Preliminary programme IEA 91.

TOM DWYER

rua Haddock Lobo 547 apto. 71
01414 São Paulo,
Brasil

Vendredi le 8 février

Cher Alain Wisner,

je profite du fait que nous sommes voisins pour passer vous laisser mon emploi de temps. J'ai eu un imprevu avec mon emploi de temps et je dois aller à Campinas de lundi à mercredi, mais je rentre tous les soirs vers 20.30h.

Par ailleurs, je serai à São Paulo ce weekend, le samedi et le dimanche soir je suis pris à partir de 19.00h. De reste, je devrais divider mon temps entre la rue et la maison. Vous pouvez me téléphoner à 280-48-48 si vous avez de temps disponible pendant la journée, *senão*, je vous propose que lundi ou mardi soir on prend "un pot" ou qu'on dîne dans un des restaurants du coin.

J'espère que votre semaine s'est bien passée sans que vous n'en êtes pas trop fatigué.

um abraço,

Tom Dwyer

HORA / HOUR 12:40

DATA / DATE 28/02/91 APT. / ROOM

SR.(A) / MR.(S) Sr Tom Dwyer de S.P.

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TELEFONARÁ DE NOVO	☐	WILL CALL AGAIN
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Alameda Santos

HOTEL GLÓRIA
RIO

MENSAGEM – MESSAGE

SR(A): Sr Wisner
MR(S):

APT. 704
ROOM

MINISTÈRE DE L'ÉDUCATION NATIONALE
CONSERVATOIRE NATIONAL DES ARTS ET MÉTIERS
ERGONOMIE ET NEUROPHYSIOLOGIE DU TRAVAIL

Paris, le 10 juillet 1990

Madame Jacqueline MESQUEITA DE ALMEIDA
(CAMPO GRANDE)

- a écrit et je lui ai répondu en 1985
- débarque sans rendez vous

- n'a pas de médicaments - un "psychologue" de Campo Grande
Mato Grosso
- va faire une maîtrise à PARIS V
↳ psychopédagogie
- professionnel : rattacher à l'Université ou la famille et al école

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veut se former en ergonomie. peut s'inscrire en cours du soir

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TOM DWYER

Double remis à Mme Monnier

7 Janvier 1991

Monsieur le Professeur Queinnec
Université Paul Sabatier
118 route de Narbonne
31062 Toulouse cedex

Cher ami,

J'ai reçu une lettre bien tardive de Tom Dwyer dont vous trouverez une photocopie ci-jointe ainsi qu'une copie de ma réponse.

Je vous adresse également une copie du texte de l'article qu'il m'a fait parvenir car il est, de toute façon, très intéressant. Toutefois, ne vous préoccupez pas trop de l'inclure dans une Table Ronde : il y a des limites à ce que l'on peut faire pour rattraper les erreurs des autres ...

Bien amicalement.

A. Wisner

P.S. Tant

Double remis à Mme Monnier

7 Janvier 1991

Monsieur Tom Dwyer
Rua Haddock Lobo 547
Apto 71
01414 Sao Paulo

Cher ami,

Merci de votre lettre du 17 Décembre. J'ai relu votre article que je trouve encore plus intéressant sous sa nouvelle forme car il serre de plus près les relations de l'ergonomie, mais comme j'ai eu moi-même des mésaventures avec les journaux britanniques d'ergonomie, je ne sais ce qui se passera car ils ont une définition très étroite de l'ergonomie.

Vous trouverez, ci-joint, la deuxième circulaire du Congrès d'Ergonomie, et vous verrez qu'hélas la date limite de réception des résumés était le 25 Octobre pour une réunion de décision qui a eu lieu fin Novembre.

Bien que j'aurais beaucoup aimé vous entendre à Paris, je pense qu'il est trop tard pour nous adresser une proposition. Toutefois, il n'est pas impossible que vous participiez à une Table Ronde sur la sécurité au travail, si cette dernière existe et si son animateur le souhaite.

Si vous êtes revenu à Sao Paulo au début Mars, je serais heureux de vous y rencontrer car j'y serai jusqu'au 13, sur l'invitation du Professeur Alfonso Fleury, Département d'Ingéniérie de l'Ecole Polytechnique. Leda Leal Ferreira, Fundacentro, Rua Capote Valente 710, s'occupe de mon emploi du temps. Son appel téléphonique est 011 853 65 88.

A bientôt, je l'espère.

Bien amicalement.

A. Wisner

J. D.

Cornell University
PROGRAM ON SCIENCE, TECHNOLOGY AND SOCIETY
632 CLARK HALL
ITHACA, NEW YORK 14853-2501
TELEPHONE 607/255-3810

Professor Alain Wisner,
CNAM,
Paris

17.XII.90

Cher Alain Wisner,

je vous envoie un nouvel exemplaire de l'article que j'avais presenté dans votre seminaire de doctorat de l'année dernière. On espère que cette fois ci le "Archiv Ergonomics" le publiera.

Ça fait un bon bout de temps que je pense vous écrire sur le Congrès Mondial d'Ergonomie, est-ce que vous pourriez m'envoyer des renseignements? Est-ce qu'il est trop tard pour soumettre un "paper" (par exemple celui-ci)? Si vous pourriez répondre à ces questions en adressant votre lettre à mon domicile: rua Haddock Lobo 547 apto 71, 01414 São Paulo. Je serai très content

J'ai très bien profité de mon temps à Cornell. Mon livre sur les accidents du travail sortira au milieu de l'année prochaine par le Plenum Press à New York... je vous enverrai, bien sûr, un exemplaire.

Je vous souhaite une très bonne année 1991,

bien amicalement,

Tom Dwyer

MINISTÈRE DE L'ÉDUCATION NATIONALE
CNAM CONSERVATOIRE NATIONAL DES ARTS ET MÉTIERS
ERGONOMIE ET NEUROPHYSIOLOGIE DU TRAVAIL

TOM DWYER Paris, le 4 Août 1989

Cher ami,

Je trouve à mon retour de vacances votre lettre du 10 juillet ainsi qu'un ensemble de documents passionnants. Je vois que vous avez encore développé votre orientation qui est de plus en plus judicieuse.

Je fais partie de ceux qui pensent depuis le début que votre apport est essentiel mais je pense aussi qu'il ne dispense pas les autres disciplines de leur effort nécessaire. Pour nous, l'analyse ergonomique du Travail qui est admirablement développée théoriquement par FINKELSTEIN THUREAU sous le titre de démarche du Cours d'Action, continue à apporter beaucoup pour montrer les conditions matérielles, d'information mais aussi sociologiques qui produisent les accidents. Nous sommes malheureux que j'aurais du fait que ce qui est appelé aussi travailleurs par les forces sociales est trop souvent contradictoire avec leurs besoins les plus élémentaires pour assurer leur sécurité. De là [illegible] peuvent être réalisées - comme le fait DANIELLOU - des ensembles méthodologiques dont on peut penser qu'ils seront plus sûrs s'ils sont élaborés avec les travailleurs et à partir de leurs savoirs, dès la conception

41, RUE GAY-LUSSAC - 75005 PARIS — ☎ (1) 43 54 18 27, (1) 43 54 18 34

Toutefois nous avons aussi l'expérience de dispositifs judicieusement conçus et organisés mais qui sont ensuite rendus dangereux du fait de diverses actions désastreuses des forces sociales. La participation des travailleurs à la conception est un moyen puissant pour que ces derniers veillent à l'esprit qui a guidé la conception et cela pendant de nombreuses années.

DEJOURS qui vient d'être nommé professeur de psychologie du travail au CNAM continue à développer sa pensée et celle de son école. Cela devrait vous intéresser.

Nous serons naturellement très heureux de vous entendre et de vous accueillir pendant votre séjour à Paris. Je ne serai à Paris qu'à partir du 25 Septembre car je serai en candidature aux USA du 2 au 24/9.

Vous trouverez ci-joint un article que j'ai rédigé sur la catastrophe de BHOPAL uniquement à partir des textes de journalistes indiens. Il n'est pas de l'ergonomie mais la défense du point de vue des travailleurs dans ce drame. Vous trouverez aussi un texte que vous connaissez peut-être et écrit pour une conférence au Japon.

A bientôt. Bien amicalement

Il est évident que votre projet CORNELL est excellent.

UNICAMP

10. VII. 89.

Cher Alain Wisner,

je vous écris du froid de l'hiver Paulista pour vous informer que je vais vivre un peu du froid de votre prochain hiver.

A partir du mi-séptembre je devrais être à Paris pour une periode de 2-3 mois. Le premier mois je serai à l'IRIS-TS (le centre de Marc Guillaume) dans le cadre d'un accord entre mon département et ce centre, j'y travaillerais sur la question des nouvelles technologies de télématique.

Au mois de décembre (si tout court bien avec les bureaucrates brésiliennes) je dois aller à l'Université de Cornell aux EUA pour 6-8 mois pour executer un projet qui devrait vous interesser fortement. J'essaierai d'établir un dialogue entre la sociologie des accidents et son ergonomie, ingenerie, médicine et psychologie. Je vous envoie le projet ci-joint (en langue portugaise)... [le document se refere à la deuxième partie de cette année dates qui, malheureusement, il fallait changer à cause des problèmes avec ~~[illegible]~~ le CNPq.]

Dans la période mi-octobre à décembre je serai en Europe dans une période "d'études libres." C'est à dire je veux travailler un nombre de thèmes de recherches qui me sont importants... entre lesquels les accidents du travail. Je vous envoie trois papers à ce redect que j'ai écrit ces derniers temps. Le premier, pour Applied Ergonomics, n'est pas encore terminé, contient une très forte demonstration de la force explicative de la théories sociologique des accidents à partir du travail d'un statisticien irlandais qui travaille à l'Université de Washington. Le deuxieme, For a Sociology of Industrial Injury, constitue une redéfinition du champ d'études de la question à partir d'une réflection sociologique: il a été envoyé à l'Australian & New Zealand Journal of Sociology. Le troisieme ~~[illegible]~~ "paper" doit sortir bientôt en France et se lie fortement au projet - il est une version un petit peu changée du chapitre 6 de mon livre.

Je crois que ces 4 textes vous donneraient une meilleure idée des directions de mes recherches que une copie entière (longue et lourde) du livre. Par ailleurs, je serai à votre disposition pour ... travailler ensemble

IFCH/DCS

Universidade Estadual de Campinas
Caixa Postal ~~1170~~ 6110
13100 Campinas SP Brasil

Telefone: PABX (0192) 39-1301
Telex: (019) 1150

et/ou répéter (dans une version "modernisée") le cours que j'ai donné il y a 3 ans lors de mon dernier séjour à Paris.

Si vous aviez le temps j'apprécierai toute commentaire sur le texte de mon projet pour les Etats Unis... et je serai très content de pouvoir travailler et débattre ces idées à Paris.

um abraço,

Tom.

P.S. il vaut mieux répondre à mon adresse privé : r. Haddock Lobo 547 apto 71,
01414 São Paulo

6 Février 1989

Monsieur Tom Dwyer
IFCH/DCS
Universidade Estadual de Campinas
Caixa Postal 1170
13100 Campinas SP Brésil

Cher ami,

Je vous remercie de votre lettre du 25 Janvier, et suis heureux des bonnes nouvelles que vous me donnez.

Nous lirons votre livre avec grand intérêt et nous recevrons avec plaisir tous les documents que vous voudrez bien nous envoyer comme vous l'avez fait avec votre lettre.

Je vous fais parvenir, sous pli séparé, quelques textes que j'ai écrits depuis quelque temps, et qui sont voisins de vos préoccupations.

Vous y verrez peut-être, qu'à mes yeux, votre approche et celle de Dejours ne sont pas contradictoires mais complémentaires.

Les diverses situations sociales que vous décrivez s'expriment par des phénomènes d'angoisse et de défense collectifs.

Toutes mes fécilitations.

Bien amicalement.

A. Wisner

UNICAMP

São Paulo

25/1/89

Cher Alain Wisner,

Vous trouverez ci-joint une copie d'un tout petit article où j'utilise de vos analyses dans des réflections dirigées à un publique d'ergonomes.

J'entre dans une phase très productive apres tellement d'années de recherches non-publiées. Mon livre sur les accidents du travail est en train d'être evalué par le MACMILLAN d'Angleterre, la revue Histoire des accidents du travail va publier une version de son sixieme chapitre, je prépare un article avec un collègue aux États Unis pour le Applied Ergonomics et il y a encore des choses à être faites sur ce sujet, surtout, je crois, dans la ligne des réflections interdisciplinaires.

A part des contacts avec Julia, Laerte et Leda, je continue d'avoir peu de rapports avec les ergonomes ici. Ils sont plus interessés dans la psychopathologie du travail et maladies que dans les accidents!

Vous trouverez aussi ci-jointe une copie d'une sommaire de mon livre, si vous avez l'interét à lire le livre ou quelques uns de ses chapitres avant sa publication faites-moi signe et je verrai s'il y a une manière pratique de l'envoyer (peut -être en disquette d'ordinateur si vous avez un systeme qui est compatible avec le mien -comme ça, ce ne sera pas trop cher).

um abraço, Tom Dwyer.

IFCH/DCS.
Universidade Estadual de Campinas
Caixa Postal 1170
13100 Campinas SP Brasil

Telefone: ~~PABX~~ (0192) 39-1301
Telex: (019) 1150

LIFE AND DEATH AT WORK-
a sociology of industrial accidents

by: TOM DWYER

INTRODUCTION

This book sets out to integrate the study of industrial accidents into the sociology of work and in so doing it is discovered that the actions of accident analysts and preventors could be more effective if they integrated sociological insights.

Chernobyl and Bhopal are two recent industrial accidents that have exposed civilian populations to death, immense risks and fear of things to come. Their production can be explained with reference to the state of social relations of work and their prevention can be perceived as having been realisable through changes in these relations. There is little analytical difference between the relations producing such accidents and those that produced many mining, construction or manufacturing accidents last century. Social relations can be perceived as giving birth to the vast majority of accidents produced in industry.

The original systematic attempts to deal with industrial accidents emphasised the building of standardised responses to risk, either through rules and

laws or the development of engineering measures. This response still dominates in today's world and a hypothesis that emanates from this book is that its dominance is responsible for maintaining accident rates higher than they would be had a sociologically informed preventative approach been adopted. The basic elements of this approach can be located in analyses made from the era in which the pre-modern notion -that accidents are a punishment for sin- was discarded. However, prevention efforts have, beyond favouring the development of industrial capitalism, the bureaucratic state and of engineering professions, systematically impeded the development of a preventive approach that places the transformation of work relations at its centre. New preventive approaches contest the standards model but, from the viewpoint of a sociological analysis, they display crucial weaknesses. These weaknesses translate into reality in accidents such as that which occurred to the Challenger and in expressions of public opposition to what are perceived of as dangerous industries.

This book situates the development of the modern notion of accidents, their prevention and compensation, in the transformation towards industrial society. This development resulted in the formation of structurally similiar interventions in all advanced countries. With the transformation towards a "post-industrial" society the nature of these interventions comes under attack

both from within and without. The redefinition of treatments of accidents that took place in the 1970's (OSHA in the US, Health and Safety at Work Act in Britain, Accident compensation Act in New Zealand, the rise in system safety on a worldwide basis- to name but a few) partly reflects this transformation, it is unlikely to be durable and, as such, leaves the field open for the building of political alliances capable of providing the backing necessary for the growth of a sociological approach.

SUMMARY

SECTION A

The most important part of the book from the "practitoner's" viewpoint is that which provides the empirical and theoretical bases to the sociological approach to industrial accidents. For both sociologists of work and accident prevention specialists this provides the missing link between the two areas of reflection.

Chapter 1. Provides an introduction to the problem of accidents, a phenomenon estimated to cost 4% of the GNP of advanced countries, to cause more injury than motor car accidents and to cause more working days lost than strikes. Two major approaches to the study of work are identified (cf Crozier), the structural and the case study approach, accidents have been traditionally

studied via the former, yet strong suggestions exist (cf Faverge) that the latter approach might reveal interesting results. Some preliminary insights from participant observation on a construction site confirm this notion.

Chapter 2. A case study investigation is conducted on a New Zealand construction site. Different workgroups are found to have different perceptions of accident causes and prevention, these perceptions, and the majority of accidents that occur, prove explicable with reference to the worker's situation within the division of labour. At certain precise points in time diverse workgroups share similiar ideas, this is explained with reference to the existence of work pressure, which means that workers act unsafely because management is using either "the carrot" or "the stick" to ensure work's completion.

In an extensive series of footnotes data gathered on this site is shown to be comparable with that gathered during the inquiry of the Building Accidents Commission in Britain in 1907.

Chapter 3. A theory of industrial accidents is built. This theory integrates considerations on labour markets (cf Sabel), orientations to work (cf Hirschmann), considerations on technological development (cf Taylor, Woodward) and managerial strategies of control (cf Fayol, Edwards). It considers that the social relation

is the manner in which the worker's relation to work is managed. Such a relation is never "given" by the technology, nor by labour markets etc., it is constructed through interaction and struggle between management and workers. Three levels of social relations are identified on the basis of a reading of sociological

literature: rewards, command and organisation. In addition a non-social level, the individual-member level is identified. The literature on industrial accidents and case studies of French construction sites are focused on through this theory, and various studies are interpreted in the light of hypotheses drawn from it. The hypotheses are developed further.

Chapter 4. A method for testing the theory is built. The ideal test would be an experimental one but the difficulties of this lead to the decision to investigate the semi-experimental situation that shiftwork provides. When such work takes place under rotating system both psychological and engineering variables are held constant, any variations that occur in accident rates must necessarily be explained by other factors. It is decided to continue to use a case study approach, but to select a number of workplaces where similiar management styles are used under different technical systems and where different management styles accompany similiar technical systems, in this way controls are increased as is the possibility of generalisation of results. A criterion of explanation is developed (cf Schutz's

reading of Weber) and the relationship between this and the theory is discussed.

Chapter 5. The theory was subjected to tests in seven workplaces, three of these are treated in some detail here. These three case studies are representative of the wider study (previously published as a research report), and demonstrate the utility of sociological explanation. The data from the seven plants is systematised and hypotheses drawn from various theoretical approaches to safety are subjected to a series of statistical tests, the sociological hypotheses are seen to have the greatest explanatory power for explaining rises and falls in accident rates.

This theory and hypotheses demonstrate the complex interactions that produce and lead to changes in accident rates. Key hypotheses validated relate to the positive influence of a certain form of workers' control and, in its absence, to a certain form of managerial control in reducing accidents.

This confirmation of the validity of the sociological approach is considered to be an insufficient condition for it to be incorporated into practice, and it is to the question of establishing the conditions for the theory's utilisation and its relationship to the whole established field of analysis and prevention that research must subsequently turn.

SECTION B

Chapter 6. The rise of industrial society was associated with changes in the perceptions of causes and the mechanisms of compensation for accidents. Based on an analysis of British coal mines the emergence of the legal approach to acident prevention is traced. The role of enginering standards in preventing accidents, in producing new accidents, in producing inequalities and in transforming employer and worker action is focused on. State intervention to enforce given standards on all workplaces favoured an industrial or modern conception

of capitalism over its primitive conception (cf Hobesbawm). The constant reference to standards broke the cultural tradition (cf Quere) by which workers analysed and reacted to the dangers of the job (cf Douglass). This breakdown was important since within this tradition existed the elements of a social critique of accident production and ideas as to how changes in social conditions could (and did) reduce accidents. The actions of both capital and labour were transformed, social peace was built up around the question of accident production.

In the area of compensation two distinct groups of workers could be identified, those made destitute by accidents and those who benefited from some protection. In the mining sector disasters made the lack of adequate indemnification a highly visible social problem. Self-help funds grew as did public criticism of

-8-

accidents. Employers counteracted with their own funds and combatted the existence of worker run funds. Employer funds became sources of social conflict and, eventually, a solution to the multiple conflicts was found, the pioneer modern social welfare system (Beveridge), State supervised compulsory accident compensation insurance.

Both accident production and prevention ceased to be subject to conflict, and the visibility of the accident problem declined.

Chapter 7. The developments focused on in Britain were copied throughout the industrialising World. In the United States the lead came from the private sector where industrial capitalists founded private safety and compensation schemes. In the latter an expansion in safety engineering occurred. In Britain government inspectorates grew.

Safety institutions develop: medicine, engineering, psychology, ergonomics, judiciary, inspectorates etc. Their functions and development are analysed. It is found that external and internal demands upon them are often contradictory, this leads to tensions on the institutions, and these are managed in three distinct ways: by submission to one set of demands at the expense of others, by the integration of contradictory demands, and by scission- where the institution divides to avoid the strains of having to deal with demands seen as incompatible.

-9-

Towards the end of the 1960's the peace that had surrounded the treatment of industrial accidents since the end of the First World War broke down. A rupture was produced in France, the United States, Britain, Australia, Italy, Canada and beyond; scientists, doctors, inspectors, judges and especially workers started questioning the dominant approaches to the treatment of accidents.

Chapter 8. The rupture forced a series of major revisions of practices. In these efforts of revision it was found that the dominant practices were, at best, meeting with little success in preventing accidents. In many advanced nations modifications in preventive practices occurred, with few exceptions these represented a continuation of already consacrated practices. However, a subtle change was occurring, institutional practices were increasingly questioned by

members. In function of this the emergence of three schools of prevention can be traced: cost-benefit analysis, standards and system safety. Struggles over safety come to be carried out between these schools.

Each school is analysed and the limitations of its action shown, these limitations result in accidents and social discontent (eg. Perrow), they may sum together to produce a new rupture in a not too distant future. The sociological theory of accident production and prevention could, in such a case step in to fill the gap, becoming a new pivot of research and action. Social

actors capable of developing the political action to support such a change are located. They can be found not only among workers and within the institutions, but also in a wider public. This public is a new actor on the industrial accident scene: it perceives itself as increasingly exposed to the risks of accidents provoked in industries subject to technocratic control and demands a democratic power capable of managing these risks.

Ergonomics New Zealand.
V. 3 no 4. December 1988.

Article:

New Challenges for Ergonomics

The Gauntlet Thrown by Recent Reflections on Industrial Safety

by Tom Dwyer

(Assistant professor, Department of Social Sciences, State University of Campinas (UNICAMP), Caixa Postal 1170, 13100 Campinas, Sao Paulo, Brazil.)*

The rise of ergonomics as a discipline and practice is intimately associated with the rise of technocratic power. This power is exercised through the transformation of knowledge into a force of production. It is applied in all aspects of life, and its generalisation has led to contemporary societies being characterised by names such as "post-industrial", "third wave" and "technocratic". In exercising its role ergonomics deals with both industrial and post-industrial forms of production, it enters into contact with approaches to industry (such as factory inspection) that have their roots in industrial society, and approaches (such as systems safety) that are post-industrial.

As a discipline ergonomics traditionally locates its difficulties of operation at various levels:

(i) Political: it sees itself as being insufficiently influential on government, industry and unions.

(ii) Internal to the discipline: it is divided between approaches that are based on differing methods and assumptions[1].

(iii) Cultural: the internationalisation of industrial processes has shown that design principles which prove efficient in one country may not be so in another[2].

In recent times, largely with the rise of post-industrial society, new difficulties have emerged for the discipline:

(iv) Technological: the new technologies require new developments in the field of ergonomics (eg in computing software, design should include reference to operator capabilities)[3].

(v) Interdisciplinarity: the former boundaries between disciplines that study work are being broken as scientific developments lead to the making of complex connections between formerly separate disciplines.[4]

(vi) The recomposition of analytical frameworks: formerly separated into disciplines, the study of work accidents (a central preoccupation and a large part of ergonomics) finds itself increasingly linked to multi-disciplinary schools of analysis: cost-benefit analysis, standards approach and systems safety.[5]

In spite of such challenges and points of instability ergonomics cannot remain paralysed by debate, it has its job to do: (a) of correcting existing job design (b) of influencing the design of new industries.

It is in the design of new and highly dangerous industries which, although small in number, are carriers of huge destructive potential, that ergonomics may have a crucial role to play. Through addressing these industries some of the crises of both industrial ergonomics and those associated with the rise of post-industrial society can be located . . . these "crises" can only be ignored at our peril. They simultaneously open up new challenges to the discipline.

Many modern high-technology processes are conceived of in such a way as to be so complex, both functionally and temporally, that operators are unable to acquire the qualifications necessary to manage work safely, and management unable to prevent their submission to disorganisation. The social nature of much post-industrial work process design has made it impossible for operators to form clear and correct images about the state of processes and the control of dangers in "exceptional" situations.

Charles Perrow in his book NORMAL ACCIDENTS, makes a distinction between component failures and system accidents. Both types of accident start with component failures, in the latter multiple failures occur and these interact in ways unanticipated by system designers and by those trained to operate these systems, in the former single or multiple failures are anticipated and comprehensible.[6] This distinction is then used by the author to interpret the Three Mile Island incident: in one sequence of events water flowed the wrong way and an unexpected accumulation of hydrogen caused the risk of explosion should pumps have been used to extract the water. These were just two incidents among the "multiple failures [that] interacted in an incomprehensible manner" during the event.[7]

Perrow's account of Three Mile Island, the CFDT's examination of the French nuclear industry and accounts of Chernobyl indicate the recurrent nature of negative effects of reliance on engineered safety.[8] At Chernobyl safety devices were unhooked in an experiment designed to increase safety, at Three Mile Island safety devices did not function, both examples show that some safety investments are ineffective. In 1980 the Indian Point Number 2 reactor sprang a leak, river water seeped into the containment building, eventually 100,000 gallons collected undetected—the moisture level indicators had been designed to detect hot and not cold water! This leak was only discovered through an operator error![9]

A mere thirteen seconds after the beginning of a series of changes that would produce the Three Mile Island incident there had been a "false signal causing the condensate pumps to fail, two valves for emergency cooling out of position and the indicator obscured, a PORV [pilot-operated relief valve] that failed to reseat, and a failed indicator of its position. The operators could have been aware of none of these."[10] In other words, the operators were denied a possibility to conduct an independent verification of what was occurring: they were denied—via the process of plant design—access to knowledge about the state of work processes.

Plants are designed to produce accidents! Workers come to treat processes as though they are in one state when in fact they are in another, thus new errors are introduced into the system. Perrow uses this principle to explain the Three Mile Island case: "They thought they were avoiding LOCA [loss of coolant accident] when they were in one and making it worse."[11]

Industries built to system safety specifications rely on human beings to run them, these human beings have their work managed by social relations.[12] Such relations are ignored in the calculi surrounding industrial and post-industrial design, designers and management are quick to blame human failure in all accidents. From Bhopal to Seveso to Challenger examples can be found of disorganisation, underqualification and authoritarianism being routinely used to manage work.[13] From the viewpoint of a sociological analysis the employ of such relations would have, sooner or later, produced accidents.

Perrow, writing an article directed at some central ergonomics issues stated there is no doubt that "system design decisions

have been associated with problems of excessive demand on opertors, tedium and withdrawal, lack of system comprehension, maintenance problems and unauthorised deviations from mandated practices."[14]

What should be done about complex industries of the type herein discussed? The reply to this question depends on who is being asked. Perrow reasons that where the impossibility of worker access to knowledge coexists with catastrophic risks to the general public and low-cost alternatives, nuclear power and weapons are examples, the industry should be abandoned. Where potential benefits and catastrophic potential are high, such as in DNA research and development, chemicals manufacture and transport, restrictive measures should be taken to design-in worker and public access to knowledge and controls on work.[15]

In the absence of these measures what should be done? The crucial political actors in industrial safety—employers—have formulated a reply. Some employers have reached the conclusion that the relations used to manage work under normal conditions may be counterproductive! In complex industries, where workers are primarily engaged in the management of exceptional events, some employers have recognised self-run work teams as the only efficient way to manage the processes. Hirschorn, in writing BEYOND MECHANISATION, has dedicated considerable effort to examining these new practices. Reflecting on Three Mile Island and other nuclear reactor incidents he argued, "we must design jobs in such a way that workers can effectively control the controls, modifying them and regulating them to prevent failures and errors unanticipated by engineers."[16] In the systems he proposes workers must be able to form an integrated vision of what goes on in their area, and have the capacity to correct it. Workers need to be able "to understand the consequences of their control decisions."[17] "[N]ew technologies . . . demand that we develop a culture of learning, an appreciation of emergent phenomena, an understanding of tacit knowledge, a feeling for interpersonal processes, and an appreciation of our organisational design choices."[18]

Current design criteria function to make it impossible for workers to develop the knowledge necessary to safely run their complex industries. Design decisions must henceforth incorporate Hirschorn's insight.

A Swedish study, after considering conventional industrial activities, makes the same point. Greater safety can be achieved when workers assist management in certain investment decisions.[19] This finding forces management's component parts—engineers, accountants, industrial medical practitioners—to redefine their traditional method of research that guides their safety interventions. In so doing, it forces them to enter into a new dialogue with specialist disciplines in the area of industrial safety.

It seems as though a space is gradually opening up within management theory for the acceptance of new notions of accident production and prevention. The opening of this space is not only driven by the emergence of post-industrial technologies and the findings of social science research but also by the perceived economic costs of traditional legal and engineering standards approaches. Rinefort's cost-benefit study proposed "human changes" as being more cost-effective than engineering ones.[20] A tradition in ergonomics has emphasised this human factor[21], but in the English speaking world it has remained in the shadow of an ergonomics that is engineering dominated.

The resolution of some of the crises of modern ergonomics would seem to pass through a recuperation of this tradition, the incorporation of the insights of modern sociology and the establishment of new relations with other disciplines acting in the field. This resolution implies that the discipline free itself of a subservience to the legal and engineering approaches that, during this century, have dominated all aspects of safety management. A ready market for a renewed approach would now appear to exist in both post-industrial work—because of a series of technological imperatives, and in industrial work—where the excessive costs and limited benefits of traditional approaches are forcing employers to search in new directions. The gauntlet has been thrown down.

Footnotes

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   Davis, P.R. 1983. Ergonomics in the United Kingdom—Another Crossroads. *Ergonomics* v. 26, n. 2, pp 121-2.
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   See also for the United States . . .

   Adato, M. et al. 1987. *Safety Second—the NRC and America's Nuclear Power Plants.* Bloomington and Indianapolis, Indiana University Press. (Union of Concerned Scientists).
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10. Perrow, C. 1984. p. 21-2.
11. Perrow, C. 1984. p. 26.
12. Dwyer, T. 1983. A New Conception of the Production of Industrial Accidents: a sociological approach. In *New Zealand Journal of Industrial Relations.* v. 8, n. 2, pp. 147-160. for an exposition of this theory.
13. Lagadec, P. 1981. *La civilisation du risque.* Paris, Seuil.

    Cerrutu, G. et al. 1977. *Survivre à Seveso?* Grenoble, Maspero and Presses Universitaire de Grenoble. are texts that discuss Seveso.

    New York Times. 28/1/85, 30/1/85 and 3/2/85 on Bhopal.

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Schwartz, H.S. 1987. On the Psychodynamics of Organisational Disaster: the Case of the Space Shuttle Challenger. *Columbia Journal of World Business*. v. 22, n. 1, pp 59-67. Develops a different explanation, using psychological categories and referring to the existence of an existential dilemma in NASA.

14. Perrow, C. 1983. The Organisational Context of Human Factors Engineering. In *Administrative Science Quarterly*. v. 28, December, pp 521-541. (p. 523).
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Tom Dwyer has a doctorate in sociology from the Ecole des hautes études en sciences sociales, Paris. He has taught at the Conservatoire National des Arts et Métiers doctoral level courses on ergonomics, and has worked as a sociologist in Australia, New Zealand and Brazil.

Conferences

The first World Conference on Accident and Injury Prevention will be held in Stockholm on 17-21 September 1989. The overall theme of the conference: "Safety—a universal concern and a responsibility for all" will be discussed in main panel sessions and will be picked up in paper presentations, workgroups and poster sessions. An invitation to submit a paper is extended to people working in the area. For further information contact:

First World Conference on Accident and Injury Prevention
c/- Stockholm Convention Bureau
P.O. Box 6911
S-10239 Stockholm
Sweden

Bits and Pieces

- Now available. Ergonomics in Industry: Proceedings of the Second Conference of the New Zealand Ergonomics Society 1988. Held at Wellington, August 1988. Topics covered: anthropometry, workplace design, design of tasks and jobs, manual materials handling, health and safety, trends in accident prevention, work environment design. 256 pages. ISBN 0-9597898-0-4. Price: Society members $28.00 incl. GST; non-members $33.60 incl. GST. Copies of the Proceedings are available from the New Zealand Ergonomics Society, 840 Tremaine Avenue, Palmerston North.

- *Dozens* of members have not lived up to their 1988 New Year's resolution to make a contribution to the newsletter. The Editor has fond hope that 1989 will see members sending in masses of information, on courses and workshops being planned, on case studies, on national and international items of interest. She also expects to be overwhelmed with letters, cartoons, offers of articles, and other contributions. Yes, dear.