

Third conference on epidemiology in occupational health

Singapore, 28—30 September 1983

organized by the Chapter of Community & Occupational Medicine and the Academy of Medicine, Singapore, under the auspices of the Scientific Committee on Epidemiology in Occupational Health, Permanent Commission and International Association on Occupational Health

OCCUPATIONAL CANCER

Epidemiologic discovery of occupational cancers

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Most recognized occupational hazards of cancer have been discovered as a result of clinical intuition or epidemiologic observation. Most could, however, have been avoided if modern laboratory techniques had been used to test the substances used before men and women were deliberately exposed to them. Industry must be expected to use such tests in the future, and it is to be hoped that few occupational hazards of cancer will be introduced. Laboratory studies, however, are not 100 % reliable as predictors of human risk, and epidemiologic observations will continue to be required (i) to detect existing hazards that have been overlooked, (ii) to pick up new hazards that were not predicted by laboratory investigation, (iii) to determine the level of risk that is socially acceptable, if a carcinogenic agent has to be used, and, sometimes, (iv) to demonstrate the safety of an agent that has been suspected of causing a hazard to man on uncertain grounds. The ways in which epidemiologic observations can be used for these purposes are discussed.

other exposures, as clearly demonstrated for tobacco smoking in man. This paper reviews research results to-date to see what conclusions can be drawn. So far as asbestos is concerned, the paper concentrates on similarities and differences between the main fiber types, possible only in studies which note exposure-response in quantitative terms. Thinking has moved away from threshold towards linear models and the implications of this change are discussed. The question of industrial processes is also considered, and recent findings are presented which suggest that there are major differences between them. The need to determine the health effects of man-made mineral fibers is pressing. Much new evidence was presented at a World Health Organization conference in Copenhagen in April 1982, but the data are still not sufficient for firm conclusions. Because of the enormous social and economic importance of mineral fibers, control will be difficult and will remain a scientific challenge for some time.

Cancer incidence in Singapore by occupational groups

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Population-based registration of all cancer cases diagnosed in Singapore began in 1968. While most of the basic demographic and clinical data collected is reasonably adequate and accurate, the item on occupation is unsatisfactory. Most notifying practitioners either do not state the patient's occupation or use general terms that do not indicate any particular environmental exposure. In spite of the difficulties, some notifications do contain specific information on occupation. For the period 1968—1977, analyses on cancer incidence in occupational groups were confined to Chinese males aged 35—64 years. Due to the lack of relevant population data, relative risks were based on the standardized relative proportional risk (SRPR), standardized for age, dialect group, and place of birth. Managers and clerical workers seem to have high SRPRs for cancer of the large bowel but low SRPRs for cancer of the lung and esophagus. High SRPRs for the lung and esophagus are seen in some groups of manual workers (eg, bricklayers, carpenters, transport equipment operators, and laborers not otherwise specified). There is also a high SRPR for skin cancer among farmers. The implications are discussed.

Mineral fibers and cancer

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Concern for the health effects of exposure to mineral fibers rose out of the commercial use of asbestos which began 100 years ago. The first problem was pulmonary fibrosis, then lung cancer, then mesothelial tumors, and, finally, other malignant diseases as well. Attention spread to other naturally occurring mineral fibers such as the zeolites, fibrous clays, wollastonite, etc, and it now focuses on the man-made fibers — glass and rock wool in particular. While the varied chemical and physical characteristics of this wide range of materials demand that differences in their biological effects be identified, the diseases which they share imply that they have important features in common. Both aerodynamic studies and research on laboratory animals have demonstrated that dimensions are critical in themselves. Also of significance is the possibility of interaction with

EPIDEMIOLOGIC STUDIES: METHODS, PROBLEMS AND SOLUTIONS

Contributions and limitations of epidemiologic knowledge in occupational health

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Although epidemiologic principles and methods in occupational medicine have been used for many years, it is only recently that the term "occupational epidemiology" has begun to appear in the field of occupational health. In fact, this is only the third meeting on "occupational epidemiology" of a scientific subcommittee of the Permanent Commission and International Association on Occupational Health. Thus the importance of epidemiology in occupational health has been recognized among not only scientists but also other members of the field and by the general public. This is indeed a desirable trend and will promote the practice of occupational health. However, epidemiology is not "almighty," not an absolute science. The misuse of epidemiologic results can provide wrong information and may even cause grave confusion and misunderstanding in the protection of the health of workers and relevant legislative action. The use of epidemiology can be broadly categorized as follows: (i) search for a cause of an occupational disease — cause-and-effect relationship of an event among workers (occupational cancer and other diseases, industrial injuries, absenteeism, detection of subclinical and psychological conditions due to job, occupational fatigue), (ii) dose-effect, dose-response relationship of toxic chemicals, (iii) practical application of epidemiologic results (establishment of criteria for the maintenance of health, industrial hygiene, policymaking for prevention and compensation — regulation and legislation). There are many problems, issues, and conflicts in the uses of occupational epidemiology. These aspects are discussed in the paper.

Statistical problems associated with cohort studies of workers in an industry

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Risk factors in a work environment are studied mainly by case-referent studies or cohort studies of workers in several occupational settings. While the cohort studies are by far more powerful in detecting risk factors, there are many problems associated with these studies, apart from the high cost and long duration. Some of these problems include the large number of variables involved, the evaluation of missing observations and the resulting bias, problems in selecting appropriate statistical models and analyses, as well as identifying the disease subgroup (including loss to follow-up). Some of these problems and possible solutions are discussed and illustrated with a study currently in progress on the mortality of workers in the nuclear industry of Canada. The study involves all the workers of Eldorado Nuclear, Ltd. from 1930 to 1980. The mortality of these workers is being ascertained by the linking of employee records with Statistics Canada mortality data. Work history includes data on dates of employment, area of work, exposure to various risk factors, and demographic information.

On the problem of controlling confounding in case-referent studies

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Individuals in various exposure categories constitute an epidemiologic study population, and its health experience over time can be taken as the base of the study [Miettinen — *Scand J Work Environ Health* 8 (1982): suppl 1, 7—14]. The base is either open with a turnover of individuals (deaths, migrations, etc) or closed, when it encompasses only originally defined individuals. In cohort studies all individuals are known in terms of membership and exposure, whereas case-referent (case-control) studies utilize a sample from the base, the referents, for information about the exposed and nonexposed domains of the base, and the referents are sort of relative denominators for the cases [also see Axelsson — *Scand J Work Environ Health* 9 (1983) 231—240]. An association in the base between the exposure and another determinant of the disease means confounding and can be fully accounted for in the cohort approach, but not in the case-referent study as relying on a sample of the base. The reason is that the occurrence of the confounder among the referents is influenced by random variation in the sampling procedure, and the referents may therefore not always reflect the true situation with regard to confounding in the base. Computer simulations of the acquisition process of referents illustrate that neither a confounded nor a nonconfounded base might be properly reflected in case-referent data. The variation of the confounding rate ratio (the crude rate ratio/standardized mortality ratio) might not be expected to vary by more than about a factor of two, however (increasing with a decreasing number of referents and with rareness of confounder). Particularly in nested case-referent studies, a large number of referents helps stabilize the random variation, but only the cohort approach provides full control of confounding, a fact that becomes more important, the smaller the effect under study. Then, in case-referent studies, the risk estimates might be rather strongly influenced by uncontrolled confounding.

The mortality odds ratio in occupational mortality studies — Selection of reference occupation(s) and reference cause(s) of death

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In occupational mortality studies, the information on the population at risk is frequently not available. Under this circumstance, the measurement of mortality odds ratio (MOR) can be used with deliberate selections of reference occupation(s) and reference disease(s). From the validity point of view, reference occupational populations should be chosen after a consideration of three aspects: (i) comparability of effects, ie, the same health effects for the index and reference occupations except the effect of the exposure under study; (ii) comparability of contrasted populations, ie, the same job entry and exit factors and similar health promotion programs if they are related to the disease under study; (iii) comparability of mortality information, ie, the same diagnostic criteria and certification procedures for the disease

of interest between the contrasted populations. The selection of reference disease(s) must also consider these three aspects for the contrasted populations with an added requirement that the exposure under study has no effect on the reference disease.

Developing job-exposure matrices for the small company

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The number of persons employed in small companies in industrialized nations represents a significant proportion of the total working population. Epidemiologic data are rarely available from this group of workers as the units are too small by themselves for valid statistical comparisons to be made and the health and exposure records that may exist are rarely compatible with one another and cannot be pooled to allow larger studies to be conducted. This paper sets out proposals for a system of recordkeeping which would allow cross-company comparisons to be made and which would be relatively cheap and easy to manage. The proposal also overcomes the weak point in most existing systems, namely, the lack of linkage between environmental measurements and individual job histories. Emphasis is placed on the need for a systematic approach with the proper collection of personal data (including the need for unique individual identification, personal medical records, and, ultimately, mortality data), together with the employment and work history and workplace exposure history. The importance of using meaningful job descriptions is underlined. Ideally workplace exposure history should include personal exposures, but where this procedure is not practicable order of magnitude levels may be used for comparative purposes. The system outlined would not require computerization and could be run by the personnel or safety officer. Such data would allow meaningful studies to be undertaken for a hitherto largely neglected sector of the working population.

Strategies for pooling data in occupational epidemiologic studies

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The purpose of this article is to review and recommend procedures for combining experience with occupational epidemiologic studies for earlier and more valid decisions concerning the protection of workers' health. Strategies A through E are compared as to advantages and disadvantages. A. *Conventional reporting of epidemiologic studies* — advantages: investigators report own data; disadvantages: many data sets unreported because small size equals small "power," early identification of hazard unlikely, common definitions and procedures unlikely. B. *Simple summation* — advantages: each uses own definitions and reference groups, apparently simple but risk of fallacy; disadvantages: may be fallacious when cases and referents have different ratios in each study. C. *Separate summation of observed and expected numbers* — advantages: each investigator uses own cases, definitions and referents, fallacy of B avoided; disadvantages: small data sets still unreported, differences in methods obscured. D. *"Clinical trial" (common protocol, definitions, analysis, and joint interpretation)* — advantages: strong body of knowledge and practice, capable of strong interpretations; disadvantages: requires network of highly

motivated collaborators in advance, unlikely that small units will be identified, costly. E. *Probability pooling* — advantages: can accommodate small and large populations, allows each investigator to define his own study design according to the local situation, strong body of statistical methods — "meta-analysis"; disadvantages: errors of study design obscured (but not different from B, C, and D), mechanism not yet available. Examples are given from exposures to anesthetics, from asbestos-exposed cohorts, and from cohorts exposed to man-made mineral fibers. Some fallacies are noted. Different strategies give different overall probabilities. Conclusion: Probability pooling is not well enough known in occupational epidemiology and, if encouraged by mechanisms sponsored by the Permanent Commission and International Association on Occupational Health, could lead to earlier and more stable decisions concerning preventable occupational hazards.

Use of questionnaires in occupational studies of pregnancy outcome

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Previous studies have demonstrated a high miscarriage risk among women working in laboratories and women exposed to anesthetic gases. Many of these studies have methodological shortcomings. The aim of the investigation was to study the pregnancy outcome, mainly the miscarriage rate, in these occupational groups and to study potential sources of error like response bias and inaccuracy of diagnosis. A questionnaire study was performed among women who had worked at a Swedish hospital, as well as among women employed in laboratories at the University of Göteborg. Reported pregnancies were accepted only if they could be verified in hospital records or if they were anamnesticallly reported in medical records. Pregnancies among nonrespondents were also sought in medical records. All women suffering a miscarriage after exposure to anesthetic gases reported their miscarriage, whereas one-third of all miscarriages occurring to women who were not exposed during pregnancy were not reported in the questionnaire. Twelve percent of the miscarriages among laboratory employees at the University could not be verified or found anamnesticallly in medical records. Work with solvents during pregnancy was more frequently reported for these miscarriages as compared to those which were found in medical records. No significantly increased miscarriage risk after exposure to solvents in laboratory work or to anesthetic gases could be demonstrated after correction for these errors. It is concluded that use of questionnaires as the only source of information in studies of pregnancy outcome could give biased results and should thus be avoided.

Byssinosis study in Hong Kong and Jakarta — Research objectives and methodology

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There are two research projects on byssinosis being carried out in Hong Kong and Jakarta. Both projects are supported by the International Development Research Centre. Initially

the research proposals were submitted independently to the Centre with considerable difference in objectives and methodology. With consultation sponsored by the Centre and the co-operative spirit of the researchers of both projects, it was agreed that the two projects should have similar objectives and methodology where practicable so that the two would produce comparable results. Both projects aim at finding the prevalence of byssinosis and chronic obstructive airway diseases in cotton textile workers and at determining the type of workers affected in relation to age, sex, duration of employment, specific nature of job, and smoking habits. The agreed methodology and the actual methods used in the actual carrying out of the study are described, the highlights being the difficulties in maintaining similarity and the deviations from the planned methods. The implications for the analysis of the results and the extent of comparability finally achieved are discussed.

Observer variation in the detection of asthma from records of peak expiratory flow

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Records of peak expiratory flow (PEF) rate, widely used in hospitals, have not been evaluated as a method of identifying cases of asthma in population surveys. Usually records are assessed by a physician, as no standard mathematical analysis has been devised, and observer variation might be a serious problem. In two factory surveys 61 subjects made two-hourly PEF records for four weeks using mini-Wright meters. Graphs were plotted of the daily mean, maximum, and minimum PEF, and four experienced observers, working independently and "blind," reported on the presence of asthma using a four-point scale. Intraobserver variation was measured with a subset of 29 duplicated graphs, and substantial agreement (on the presence or absence of asthma within two-scale points) was seen in 90–100 %, and complete agreement in 76–93 % of the cases. Interobserver variation was greater, with substantial agreement in 69 % and complete agreement in 48 % of the cases. However, in 97 % of the cases, at least three observers showed substantial agreement, and for observer pairs this agreement varied from 72 to 93 %. In their reporting, the observers used within-day and between-day PEF changes and regarded some appearances as spurious. Observer variation may have been overestimated as this study deliberately used two definitions or guidelines, but it must be taken into account in epidemiologic work using these records.

Excess cancer incidence among patients with carbon disulfide poisoning: A result arising from a biased cohort?

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The Finnish Register of Occupational Diseases includes 100 men with a diagnosis of chronic carbon disulfide (CS₂) poisoning in 1964–1974. By the end of 1975 seven of the men had contracted cancer. There were 3 (0.93 expected) lung cancers, 3 (0.29 expected) stomach cancers, and 1 semi-

noma. For the lung and stomach cancers an age-adjusted expected value of 1.23 gives an observed : expected ratio of 4.9 ($p < 0.01$). The results are in contrast with those of a Finnish mortality study of 343 CS₂-exposed men: 14 cancer deaths occurred among the exposed and 19 among the referents (Nurminen & Hernberg, this symposium). The contrasting cancer morbidities in the exposure and outcome cohorts could be speculated in several ways. Lung cancers occurred 2, 2, and 3 years and stomach cancer 3, 10, and 14 years after the diagnosis of CS₂ poisoning. Neuropathy was an important diagnostic criterion of chronic CS₂ poisoning. Paraneoplastic neuropathies may emerge years before the actual manifestation of cancers. Alcohol consumption associates with cancer morbidity and neuropathies. If workers with paraneoplastic or alcoholic neuropathy are exposed to CS₂, their chances to be labelled as cases of CS₂ poisoning are high, and the outcome cohort becomes biased. In a study of this possibility among the 100 men (CS₂ poisoning diagnosis), each cancer case was matched with three non-cancer cases according to age and year of diagnosis of CS₂ poisoning. A blind analysis of their medical files showed a shorter mean exposure duration (11.4 vs 16.5 years, $p < 0.05$) and less diagnostic conviction as to the CS₂ poisoning ($p = 0.05$) for the patients that later developed cancer than for those who did not. The findings suggest that some of the subjects with cancer did not actually belong to the cohort of cases with "true" chronic CS₂ poisoning.

A review of methodological issues of the standardized mortality ratio in occupational epidemiology

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While the standardized mortality ratio (SMR) is a well established form of summary statistics commonly employed in occupational cohort studies, misconception and confusion as to the merit and correct use of the SMR still persist. This paper attempts to clarify many methodological issues of the SMR, such as when and how comparisons of SMRs can be made, the role of SMRs versus age- and time-specific mortality ratios (MRs), whether the SMR is equivalent to relative risk, the extent to which the SMR is related to life expectancy and to statistics derived from direct standardization, how the SMR is affected by the choice of the standard population and the length of observation, how the SMR contributes to the "healthy worker effect," and how the SMR is affected by competing risks. These issues are discussed and illustrated in this review with mathematical and empirical support. For example, a correction procedure is proposed to permit direct comparisons of SMRs after adjustment for dissimilar age distributions. In addition a new proposal for testing the heterogeneity of age-specific MRs is presented. When MRs are homogeneous, this method can statistically compare two SMRs. When MRs are not homogeneous, it can also test the significance of the relative risk between two sets of age-specific MRs. The supporting data for these procedures come from a large cohort of refinery workers. Since the SMR will continue to be widely used, a thorough understanding of its characteristics is essential to ensure accurate interpretations of study findings. In addition there is a need to present more than the SMR as the summary statistic in describing the complete picture of the health (mortality) experience of a cohort. These statistics should include at least (i) relative risk (SMR), (ii) attributable risk, and (iii) life expectancy — all of which complement each other and can be derived from or approximated by the data that generated the SMR.

The impact of competing risks of relative risk in occupational studies

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Adjustment for competing risks is desirable and sometimes necessary for the comparison of mortality from a specific cause in two populations if there is a substantial difference in the forces of mortality from all remaining causes. This adjustment is particularly needed in occupational cohort studies where an interpretation of excess cancer risk may be complicated by the presence of the healthy worker effect arising from significantly decreased noncancer mortality. In this paper, a method has been developed for adjusting competing causes of death in the calculation of relative risk. Two examples are given to demonstrate the effect of competing risks, one comparing cancer mortality among US white males for 1968 and 1977 (a substantial reduction of heart disease mortality occurred during this period) and the other comparing cancer mortality in a cohort of refinery workers with that of the US white male population (a healthy worker effect was observed). In both instances, adjustment of the differential noncancer force of mortality is warranted in the calculation of relative risk. Three factors have been identified as determining the significance of competing risks: (i) the magnitude of the overall mortality risk of the study population; (ii) the differential risk for all other causes between two populations or the adjustment factor; and (iii) the age intervals used in the mortality calculation. Thus the impact of competing risks is increased if the mortality risks of the study population is high, if the differential risk for all other causes is large, or if wide age intervals are used in the mortality calculation. Consideration of competing risks in the data from a refinery cohort study has shown that the relative risk in certain age groups unadjusted for competing risk tends to overestimate by as much as 8 %. However, the overall impact of competing risks on actual results is relatively small unless one of the three factors mentioned is unusually large. Furthermore, if relative risk is expressed in terms of the ratio of mortality rates, competing risks can be ignored.

mild cases of chronic metallic mercury poisoning, were re-examined after two months of hospital admission and chelation treatment with unithiol or sodium dimercaptosuccinate (Na-DMS). The most common symptoms and signs in both groups at the time diagnosis were dizziness, insomnia, fatigue, finger tremor, toothache, and bleeding gums. They had all improved to some extent during the follow-up period. Noticeably, 15 severe cases in group 1 who had had ataxia and coarse shakes which made it difficult to pick up food with chopsticks at the time of diagnosis no longer had a disturbance of fine movement after removal from mercury exposure for one to two years without any chelation therapy. This improvement suggested that the ataxia induced by metallic mercury poisoning was reversible. However, upon re-examination, finger tremor could still be detected in 31 cases of group 1. The longest period of cessation of mercury exposure in these cases was 11 years. Stomal signs such as gum atrophy, loose teeth, and loss of teeth also remained nearly unchanged in both groups. The mean urinary mercury level in group 2 was 0.224 mg/l at the time of diagnosis, and it had decreased to 0.0413 mg/l upon reexamination two months later due to the effect of unithiol. In group 1 there were only 12 cases showing increased urinary mercury levels (> 0.045 mg/l) on reexamination, the longest period of termination of mercury exposure being 11.5 years in these cases. Three patients of group 1 with normal urinary mercury levels received a provocation test with unithiol showing increased urinary mercury. This result gave evidence of an accumulation of mercury in these cases even after removal from mercury exposure for 4–15 years, a finding which suggested that chelation treatment with unithiol is advisable for all patients suffering from chronic metallic mercury poisoning. Based on clinical evaluation, the condition of the patients in both groups had improved, even in severe cases. The overall prognosis of chronic metallic mercury poisoning in mercury refinery workers was encouraging after the termination of mercury exposure. Chelation therapy with unithiol or Na-DMS was evidently beneficial for reducing urinary mercury levels and some symptoms, but not for decreasing neurological and stomal signs.

HEALTH OF WORKERS IN SPECIFIC OCCUPATIONS

Prognosis of chronic mercury poisoning in mercury refinery workers

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The prognosis of chronic metallic mercury poisoning in two groups of patients from the mercury refinery of a mercury mine was evaluated by reexamination which included an interview, physical and neurological examinations, and the determination of urinary mercury. Group 1 consisted of 70 male patients, aged 31–69 years, who were exposed to metallic mercury for 1.6–17.8 years and had been diagnosed 10 years earlier as having severe (15 patients) or moderate (55 patients) chronic metallic mercury poisoning. At the time of the reexamination they had been removed from mercury exposure for 2 months–17 years. None of them had been treated with any chelating agent. Group 2, 84 male patients, aged 24–62 years, who were from the same mercury mine, had been exposed to metallic mercury for 2–10 years after 1962, and had been previously diagnosed as having

Mortality among cadmium workers in Sweden

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Occupational exposure to cadmium can induce both renal and pulmonary disease. An increased risk for prostatic cancer has also been suggested, and, recently, animal carcinogenicity. This cohort comprised 525 male workers in a cadmium-nickel battery factory in Sweden. The men were exposed to cadmium for more than one year between 1940 and 1980. The observed number of deaths due to different diseases was compared to the expected number, calculated from national statistics. The exposure to cadmium and nickel was very high during the 1940s and 1950s, often close to 1 mg/m³. During the last three decades the exposure has been successively lowered, and since 1977 it has seldom exceeded 0.02 mg/m³ as an 8-h time-weighted average. Between 1951 and 1980, 105 men died before the age of 80 years in comparison to an expected number of 122. In a subgroup of 185 workers who were exposed for more than 15 years, 51 had died in comparison to an expected number of 58. Among these 51 men, there was a significant increase in deaths from nephritis and nephrosis (3 observed, 0.4 expected). Furthermore nonsignificant increases were ob-

served for cancer of the prostate (3 observed, 1.6 expected) and urinary bladder cancer (2 observed, 0.4 expected). Three pulmonary cancers were observed, and 2.5 were expected. Among those workers who had been exposed less than 15 years, there was an excess of chronic obstructive lung diseases (3 observed, 0.9 expected). No generally increased mortality was found among those employed for a long time during the high-exposed periods although increased mortality from chronic kidney and lung disorders was verified. Additional occupational groups with cadmium exposure are being followed, and metal workers without cadmium exposure will be used for reference.

An epidemiologic study of lung functions and hearing acuity among Singapore firemen

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This study was conducted on 506 firemen in Singapore. Interviews, pulmonary function tests, and audiometry were carried out. With regard to pulmonary function, the results showed that forced vital capacity (FVC) increased up to the age of 25–30 years for both the Chinese and the Malays. Both FVC and forced expiratory volume in 1 s ($FEV_{1.0}$) increased with standing height over the whole age range studied. The mean values of FVC and $FEV_{1.0}$ were higher for the Chinese. It was also found that the FVC of the subjects in the study showed a greater decline in rate with age than other workers studied by the authors previously. The hearing threshold of 82 fire fighters showed a prominent upward shift of 6–8 KHz at ages 20–30 years. This upward shift was more pronounced for the right ear. The implications of the findings are discussed, and a comparison with results of other similar studies in other countries is made.

Mortality from cardio- and cerebrovascular diseases among dynamite workers — An extended case-referent study

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Increased mortality from cardio- and cerebrovascular diseases among male dynamite workers was reported in 1977 and was supported two years later by findings of a small cohort study from another Swedish dynamite population. The excess risk was confined to those with long-term employment. The original case-referent study [Hogstedt & Axelson — *J Occup Med* 19 (1977) 675–678] comprised the years between 1955 and 1975, and the register of deaths and burials in the parish around the dynamite factory was used as the source of subjects. The same register has now been used for the time period 1976–1980. We have used identical requirements for this extension as in the original study, i.e., confined to men with more than one year of employment and aged 36–70 years. Cases were those who died from ischemic heart diseases and cerebrovascular diseases according to classification rules of the World Health Organization, and referents were those who died from all other diseases remaining after the primary exclusions. One hundred and one men had died in the parish during the extension period. Eleven were excluded. There were 36 deaths from heart dis-

eases, 13 from cerebrovascular diseases, and 41 referent diagnoses. Six of the “heart cases,” five of the “cerebrovascular cases,” and six of the referents were exposed. The increased risk for cerebrovascular deaths among the dynamite workers was significant. The Mantel-Haenszel estimation of the risk ratio for cerebrovascular diseases during the period 1955–1980 was 3.8 (95 % confidence interval 1.5–9.7) and 2.6 for cardiovascular diseases (1.3–5.3). Among 26 men exposed more than 20 years only one died from anything other than a cardio- or cerebrovascular disease. The extended study confirms that cerebro- as well as cardiovascular diseases are in significant excess among dynamite workers but that the excess risk remains to be limited to those with long-term employment.

Lung cancer and other causes of death among licensed pesticide applicators

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The mortality experience of a cohort of 3,827 white men licensed to apply pesticides in Florida was evaluated to investigate health effects associated with chronic exposure to pesticides. Although the overall standardized mortality ratio (SMR) for these structural pest control workers was not significantly elevated (SMR = 103), excess deaths were observed for leukemia, particularly acute myeloid leukemia (3 observed vs 0.9 expected), and cancers of the brain (SMR = 200) and lung (SMR = 135). The risk of lung cancer rose with the number of years licensed < 10 years, 10–19 years, and > 20 years, respectively. Ratios of directly adjusted rates showed similar patterns with observed : expected ratios of 100, 175, and 186 for the length of licensure categories. Mortality from lung cancer was greater among persons first licensed before age 40 (SMR = 234) than among those first licensed after age 40 (SMR = 115). Although information on tobacco use was not available, the increasing risk of lung cancer with number of years licensed and the capacity of certain pesticides to produce neoplasms in laboratory animals suggest that some pesticides may be carcinogenic in humans.

Hand eczema among construction workers: Prevalence and association with occupational exposure

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The purpose of this study was to obtain an estimate of the prevalence of skin diseases on the hands and forearms of construction workers and to examine the role of occupational exposure, with the use of a case-referent study within a cross-sectional design. A random sample was drawn from all construction companies located in the northern part of The Netherlands. An examination of the hands and forearms of all workers of these companies (about 1,700 construction workers) demonstrated that a form of eczema was present for 133 (7.8 %), whereas psoriasis was observed for

22 (1.3 %). Irritant dermatitis was the major diagnostic category. It was found on 67 (4 %) while allergic contact eczema was present on 1.4 % of the workers. The prevalence of eczema/dermatitis in different job categories varied between 5.9 % for technicians and 12.6 % for bricklayers and plasterers. A history of atopy was more prevalent among persons with irritant dermatitis (24 %) in comparison with other forms of eczema (15 %) and controls (11 %). Patch testing was performed with dichromate, cobalt, thiuram mix, and epoxy resin for persons with eczema and a reference group of 307 workers without eczema. Positive patch tests were found for 15 % of the workers with eczema and 5.5 % of the referents. For carpenters there was virtually no difference in the proportion of positive patch tests among workers with eczema (6.1 %) and referents (4.3 %), whereas for bricklayers and plasterers these percentages were 27.5 and 7.6, respectively. For the carpenters the odds ratios of exposure demonstrated an association between eczema and a history of frequent exposure to wood impregnants and solvents. Logistic regression analysis demonstrated also that, for carpenters, allergy played no significant role and that special attention should be given to irritants. The associations may have been underestimated by bias, especially recall bias, withdrawal bias, and prevalence-incidence bias.

Five cases of arsine poisoning

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Arsine is one of the most potent hemolytic agents found in industry. The cases of four workers are presented who had abdominal pain and jaundice and who passed tea-colored urine. A fifth worker also passed dark urine but had no other symptoms. Investigations revealed that all five workers were from a tin smelting plant, where they were involved in mixing tin ore with dross. They were exposed to arsine gas after mixing a particularly large quantity of dross with tin ore, which was wet because of rain. Three of the cases developed renal impairment and also a mild sensory neuropathy. All survived with proper hospital management, which included exchange blood transfusions and peritoneal dialysis where indicated. Prevention of such poisoning includes keeping dross away from all moisture, good ventilation in work areas, and adding of the dross directly to the furnace.

An epidemiologic study on the mortality pattern of chromate pigment workers in Japan

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This report concerns an epidemiologic study on the mortality pattern of workers at five factories manufacturing chromate pigments in Japan. The first retrospective study was carried out in 1975 on the 669 male and 40 female workers. The second cohort study was then started, from January 1950 to June 1980, on the 11,704 male and 836 female person-years. The excess deaths and the ratio observed

during the period of the cohort study for male workers were as follows: malignant tumors, total: observed 9 : expected 10.25 (0.88); lung: 1:1.21 (0.83); esophagus: 2:0.44 (4.59); stomach: 1:4.00 (0.25); colon: 2:0.36 (5.51); liver: 1:1.08 (0.92); pancreas: 1:0.45 (2.24); heart disease: 3:4.92 (0.61); apoplexy: 4:8.05 (0.50); lung disease: 2:1.60 (1.25); cirrhosis of the liver: 1:1.87 (0.53); others: 1:4.71 (0.37); accident: 2:8.94 (0.22); all causes of death: 5:8.74 (0.57).

OCCUPATIONAL CANCER

Mortality from nasopharyngeal carcinoma and occupations of men in Hong Kong from 1976 to 1981

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An analysis of registered death data in Hong Kong was conducted on the relationship between nasopharyngeal carcinoma and major occupational groups for the years 1976–1981. Deaths of men from this form of carcinoma and from all causes and the 1976 and 1981 population census were used to obtain mortality rates and proportionate mortality ratios to show the variations among different occupations. The results showed that mortality rates from nasopharyngeal carcinoma were the highest for agricultural and fishery workers ($p < 0.05$) when compared to those of all other major categories of manual and non-manual workers (based on ISCO, 1968). Administrative and managerial workers had the lowest mortality. This pattern of mortality from nasopharyngeal carcinoma among different occupational groups remained when specific analyses of places of origin were made. The factors accounting for the variations in deaths from nasopharyngeal carcinoma in these occupational groups by age and place of origin are presented in detail and discussed.

Fiber exposure and mortality in chrysotile production in Quebec, 1910–1975

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We have surveyed the cohort of all persons (10,939 men and 440 women) who were born in 1891–1920 and who had worked in the mines and mills of Quebec for a month or more before 1967. The aims of the survey were to define the relationships between exposure to chrysotile and death from lung cancer, certain other cancers, and pneumoconiosis. (Mesothelioma requires separate study; the only other major excesses of mortality were due to respiratory tuberculosis and accidents.) By the end of 1975, 4,463 of the men had died, 634 from the causes of special interest. For each of these 634 deaths referents were selected, at random, from among men in the cohort born in the same year as the case and known to have survived to a greater age. Initially cases were compared with referents in terms of dust exposure [(million particles per cubic foot) $\times$ years] accumulated up to nine years before the death of the case. We have since described how we estimated workplace fiber counts so that each man's exposure could be accumulated in fibers per mil-

liliter times years. The mean exposures for all the subjects (634 deceased and over 1,500 referents) were found to be 828.3 (fibers/ml) $\times$ years and 239.4 million particles per cubic foot $\times$ years. The ratio 3.46 (fibers/ml)/million particles per cubic foot compares with the earlier 3.64 (inaccurately reported as 3.14). Relative risks (RR) were related to exposure by a new form of matched analysis. For *lung cancer* and *pneumoconiosis*, linear relationships [$RR = 1 \pm \beta \times (\text{fibers/ml}) \times \text{years}$] fitted well, β being estimated as 0.00038 and 0.00647, respectively. For *cancer of the esophagus* and *stomach*, the form was far from linear, but very severe exposures were associated with high risks. For *cancer of the colon* and *rectum* the form was also irregular, and the association less clear. For *other abdominal cancers* and *laryngeal cancer* risks and exposures were not positively associated. The asbestos-smoking interaction in lung cancer appeared closer to multiplicative than to additive.

Lung cancer among underground workers in the iron ore mine in Kiruna on the basis of 30 years of observation

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The mortality from lung cancer among workers in the Kiruna iron mine, where the radon concentration in the past has been above 0.3 working levels, has previously been studied for the period 1951–1970. The present study is a follow-up of the same population having worked underground in 1971–1980 and aged 30–74 years, and an evaluation of the trend is attempted based on the period 1951–1980. Fifteen cases of lung cancer were observed and 4.6 expected based on the mortality from lung cancer among men in Sweden in the same period and age group. The mortality rate per 10⁴ person-years was 4.7. In the 1951–1970 study 13 cases were observed and 4.2 expected. The mortality rate per 10⁴ person-years was 12.0. The correlation between the latency period and time of entrance into underground work was studied for the cases in the two studies separately. The cases of lung cancer occurring in 1971–1980 were found to have a 10-year longer latency period than the cases occurring in 1951–1970, which may be due to a significant change in smoking habits. The accumulated mortality from lung cancer observed in 1930–1980 among the population working underground in 1921–1950 was 38.8 cases per 10⁴ person-years (30- to 74-year age group). On the assumption that the mortality rate for 1951–1980 is the same as that for 1921–1950, the expected number of lung cancers from the population having worked underground in 1951–1980 is 88. So far only seven cases have been observed. This result underlines the severity of the problem which has not been solved by a lowered radon concentration in the mine. For many years a considerable excess mortality from lung cancer will continue to strike those workers already exposed.

Primary liver cancer and solvent exposure

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A case-referent study on a possible connection between primary liver cancer (International Classification of Diseases 155.0) and solvent exposure has been carried out. In all, 374 cases were reported to the Finnish Cancer Register in 1979 and 1980. After the exclusion of wrong diagnoses, non-respondents, and cases for whom the primary site was un-

certain, 126 cases (64 males and 62 females) remained. Each case was matched for sex, age $\pm$ five years, vital status, and geographic district with two cases of coronary infarction, selected blindly from hospital records. Nonresponse (38 %) reduced the number to 175 referents (82 males and 92 females). A questionnaire on past employments and tasks was mailed to alive subjects (6 + 6) and to the next-of-kin of deceased patients. An industrial hygienist then evaluated the exposure history blindly and, whenever needed, contacted the workplace or the next-of-kin for more details. Only exposures commencing > 10 years before diagnosis were considered. Altogether six female cases but no referents had been exposed to solvents. One had been exposed to chlorinated solvents in dry cleaning, while two others had used both carbon tetrachloride and aromatic and aliphatic solvents. Three cases had been exposed to mixtures of aliphatic and aromatic solvents, but no chlorinated hydrocarbons. By contrast, the males showed no differences in solvent exposure. Three cases and five referents were classified as having been exposed to solvent mixtures. These results are hypothesis-generating only, and the excess solvent exposure found for females must be confirmed in other studies before any conclusions can be drawn.

A possible carcinogenic threshold for arsenic exposure

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Peak arsenic exposure, rather than cumulative exposure, is found to be the primary determinant of carcinogenic risk. Analysis of lung cancer risk among Montana smeltermen by exposure history revealed no excess lung cancer for workers whose exposure was kept below 500 $\mu\text{g}/\text{m}^3$. A number of mortality studies from the cohort of 8,045 men employed for at least one year during 1938–1956 have been reported. The studies of Lee & Fraumeni (1969) and of Lee-Feldstein (1983) with follow-up through December 1963 and September 1977, respectively, found excess lung cancer mortality in every exposure group. Their exposure categories of heavy, medium, and light were based on unpublished data which was only released in a 1975 public hearing. Analysis of this data (Morris 1975) revealed overlapping categories and misclassification of exposure areas. Higgins (1982) has conducted a mortality study (through December 1977) of a stratified sample of this cohort, using individualized work histories with departmental assignments of exposure levels. The Higgins study used distinct exposure categories and demonstrated excess lung cancer mortality only among workers assigned to areas with exposures greater than 500 $\mu\text{g}/\text{m}^3$. Workers restricted to areas not exceeding 500 $\mu\text{g}/\text{m}^3$ demonstrated no excess lung cancer mortality. Extension of this study and its analysis is now underway. This quantitative data interpretation is consistent with the qualitative assessment derived from other published studies. Together, they may begin to provide an epidemiologic demonstration of a quantitative human threshold in carcinogenic risk.

Mortality study of stainless steel welders

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The objective of this multicentric epidemiologic study was to investigate a possible cancer risk associated with the use of nickel-containing electrodes in the welding of stainless

steel. A retrospective follow-up study was designed, the cohort comprising 1,294 welders who were followed-up from 1950 for specific causes of death. The internal reference group consisted of 1,799 toolmakers selected from the same 16 enterprises from which the welders originated. The follow-up was completed for 96.4 % of the welders and 95.2 % of the reference group. Among the 81 deaths of welders, 24 were caused by cancer, compared with 33 cancers among 167 deaths in the reference group. The risk ratios were calculated on the basis of person-years, and the distribution of specific types of cancer was compared with the corresponding distribution for the internal reference group (after stratification for age and adjustment for smoking) and with external reference population mortality rates. The internal comparison showed a higher risk of dying from gastrointestinal neoplasms and from mesothelioma (of the pleura and of the peritoneum) among welders. The external comparison clearly revealed an absence of a healthy worker effect after more than 20 years from first exposure for welders, whereas such an effect persisted throughout the whole observation period within the toolmakers' cohort. In addition the cancer risk in general gradually increased with time after first exposure, being highest (risk ratio 6.0) after 30 years. The importance of long-term exposure to coated electrodes versus other types of exposure is discussed, and some clues for further research into detailed exposure data are given. For this purpose a special "case study" is underway.

Asbestosis, the nervous system and cancer

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Paraneoplastic involvement of the nervous system, and particularly peripheral neuropathy, is often encountered in cancer patients, even at very early stages of the disease. Asbestosis patients have a high cumulative risk of cancer; four of ten asbestosis patients develop cancer. To study the paraneoplastic neuropathy that possibly occurs among asbestosis patients, we formed a small cohort (115 asbestosis patients, mean age 56 years, mean exposure to asbestos 21 years) in 1979. Neurological examination revealed slight peripheral neuropathy in 44 (39 %) of the patients, 24 (22 %) of whom also had central nervous system signs (disturbances in gait and station, memory, and fine motorics). The prevalence of peripheral neuropathy among asbestosis patients was clearly higher than among age-matched referents with fibrosing alveolitis, asthma patients, or patients with suspected solvent poisoning. The patients with rapidly progressing asbestosis ($N = 26$) showed fewer signs than those with slowly progressing asbestosis although the former had more severe subjective symptoms. No significant differences were found between the patients with or without peripheral neuropathy regarding the following parameters: pulmonary function tests; tumor markers, (CEA, ferritin β 2-microglobulin); antinuclear antibodies; C3; C4; and circulating immune complexes. Nevertheless, at the group level, the asbestosis patients had increased levels of the three tumor markers. The exceptionally high prevalence of peripheral neuropathy among asbestosis patients may reflect a paraneoplastic phenomenon, and it makes further follow-up of this cohort very interesting. So far the number of verified cancer patients is too small ($N = 10$) to enable any conclusions about the value of neuropathy in the early diagnosis of this type of occupational cancer.

SICKNESS ABSENCE

A study of uncertified short-term sickness absence in the National Health Service

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Uncertified sickness absence was examined for the underlying causes through the application of symmetrical bivariate negative binomial distribution, the Pearson correlation coefficient, and the product moment correlation coefficient. The cause behind 1-d spells were nonmedical, as it was shown that 1-d spells were a proneness phenomenon, and for those employees exhibiting it, it appeared to be a stable trait. An association also existed between 1-d spells and turnover rate, as well as between 1-d spells and lateness, both turnover rate and lateness being an index of dissatisfaction. It was also shown that 1-d spells differed from certified spells by being randomly distributed among the days of the week and the months of the year, whereas certified spells showed highly significant differences in their distribution among the days of the week and the months of the year. All the different approaches suggest that nonmedical factors are of great significance.

Absenteeism due to sickness and work accidents in a modern hospital

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The study aimed at clarifying the role of sex, age, occupation, and duration of hospital employment in the shaping of patterns of sickness absenteeism as a whole and the particular segment caused by work accidents. For this purpose the respective annual incidence rates, mean day losses per worker, and mean duration of the spell of absence were calculated for different groups of hospital employees. For the entire staff (about 3,000 workers) absenteeism rates caused by sickness and accidents, respectively, were an incidence per 100 workers of 270 and 7, a mean number of days lost per worker of 11.5 and 1.0, and a mean duration of spell of absence of 4.3 and 14.3 d. The contribution of work accidents to the whole sickness absenteeism was estimated as 2.5 % of the total incidence of spells of absence and as 8.4 % of the total number of days lost. Sickness absenteeism rates were higher for the women, while those rates associated with work accidents were higher for the men. The extent of the sickness absenteeism of the men was slightly higher among the elder workers, whereas the level of absenteeism caused by work accidents was exceptionally high for the youngest employees. For the women absenteeism rates of both kinds increased with age. The levels of sickness, as well as of accident-caused, absenteeism were the highest in the groups of skilled and unskilled workers and the lowest among doctors. Sickness absenteeism rates overtly increased with duration of hospital employment; on the other hand, the extent of absenteeism caused by work accidents was the highest among the workers employed for less than one year. Thus the following segments of the hospital staff may be identified as high-risk groups: elder females, especially unskilled ones with seniority of more than 20 years (for

sickness absenteeism), and young males, skilled and unskilled, recently employed in the hospital (for accident-caused absenteeism). The planning and carrying out of any preventive measures should consider these groups as a primary target.

An analysis of sickness absence and clinic visits among employees in a company in Kuwait

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A study was conducted to determine the frequency of visits to a company clinic by, and incidence of sickness absence among, a population of about 1,750 employees of a company in Kuwait. The company is engaged in a variety of activities, including sales, service and repairs of automobiles, boats, office equipment, electrical and electronic appliances, and the design, fabrication, installation and maintenance of central air-conditioning systems. Company divisions are located throughout Kuwait, and there are company clinics at two locations. Data on visits to one of the clinics were collected from records of the medical department for a period of four years. Among an average population of 1,035 employees at risk, the mean frequency of visits per employee for each of the years was 6.36, 6.43, 6.27, and 5.99. Data on sickness absence were collected from computerized records for a period of two years. Among an average population of 1,751 employees at risk the mean incidence of illnesses and injuries other than work injuries, resulting in absence, was 0.50 and 0.44 % per workday for each of the two years; and the mean incidence of work injuries for each of the two years was 0.09 and 0.06 % per workday. The mean duration of absence due to illnesses and injuries other than work injuries was 2.87 and 2.74 days per employee per year, and the mean duration of absence due to work injuries was 1.27 and 1.08 days per employee per year. These data are being further analyzed to ascertain associations between clinic use, work injuries, other illnesses and injuries, and several independent variables, including temporal factors, the nature of work, location of workplace, and its distance from the clinic.

Sickness absence in a Singapore refinery

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Most of the literature on sickness absenteeism is derived from western countries where absenteeism is high and has been rising over the years. Less is known of the situation in the newly developed countries of the east. This paper analyzes sickness absenteeism among male industrial employees in a major oil refinery in Singapore in 1982. On the average, each worker had 5.1 spells and 7.0 workdays of absence attributed to illness. Absenteeism increased with age, and shift workers were found to have twice as much sick leave as day workers. However more younger workers had longer durations of absence than older workers. This last finding can be explained by the fact that the chronic medical conditions more commonly associated with increasing age do not contribute significantly to long spells of absence. A variety of surgical operations, followed by accident, were the main causes of long absences. The absence rate of 7.0 days per worker was much lower than most of the published data from Europe, and it was comparable to that of two shipyards in Singapore.

OCCUPATIONAL NEUROTOXICITY

A prospective study on the early neurotoxic effect of lead

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A prospective follow-up study on new lead workers who entered a storage battery factory was carried out between 1975 and 1981. Nerve conduction velocities and psychological performance were recorded before the commencement of exposure and after one, two, and four years of work. Out of an initial number of 89 workers, 23 were available for the one-year, 16 for the two-year, and 11 for the four-year reexamination. The reference group comprised nonexposed workers of a cable manufacturing plant and an electrical power plant. Especially the sensory conduction velocities of the median nerve decreased during the two-year follow-up. When the exposed workers were divided into two groups according to the median blood lead values ($27-30 \mu\text{g}/100 \text{ ml}$ or $1.3-1.4 \mu\text{mol}/\text{l}$), the higher exposure group showed slower values for several motor and sensory conduction velocities than the lower exposure group at the one- and two-year reexamination. In addition visual intelligence and visuomotor functions were impaired significantly. The learning effect for some psychological tests, which was clearly evident among the referents, was almost absent among the lead workers. After four years only 11 lead workers remained. This small number of subjects, together with selection in the dropout, resulted in a decrease in the group differences found for conduction velocities and psychological tests so that a statistical significance was no longer evident.

The effects of allyl chloride on occupationally exposed subjects

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Effects of allyl chloride on occupationally exposed subjects in two factories manufacturing sodium allyl sulfonate were studied. Twenty-six subjects in factory A and 27 workers in factory B were exposed to allyl chloride at levels of $2.6-6,650 \text{ mg}/\text{m}^3$ for 2.5 months to 6 years and $0-25.13 \text{ mg}/\text{m}^3$ for 1-4.5 years, respectively. All the subjects were given detailed questionnaires and physical and neurological examinations, and electroneuromyographic (ENMG) observations were made. Most of the subjects of factory A had weakness, paresthesia, and numbness in extremities with sensory impairment in the glove-stocking distribution, as well as reduced ankle reflexes. The ENMG showed neurogenic abnormalities in 10 of the 19 examined subjects, a finding which provided evidence of neuropathy at a prevalence of 52.6 %. Among the 10 three cases with fibrillations and positive sharp waves in the ENMG were clinically severe cases. Those having similar symptoms in factory B were clinically much milder with few abnormal neurological signs. Yet neuropathic ENMG findings shown as increased polyphasic potentials and prolonged mean potential duration indicating partial denervation and reinnervation were found in 13 out of 27 subjects. Apart from the polyneuropathic manifestations mentioned, no significant abnormalities of other organs were noted in the physical examination, electrocardiogram, and laboratory tests, including routine blood and urine tests, determination of liver and renal functions, blood glucose, electrolytes, and erythrocyte sedimentation rate. Possible etiologic factors other than exposure to

allyl chloride were excluded. All the evidence obtained indicates that chronic exposure to allyl chloride mainly causes toxic polyneuropathy. The neurotoxicity of allyl chloride has also been confirmed by experimental neuropathological studies.

ACCIDENTS AT WORK

A study of work injuries in eight Asian countries

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This study was based on a survey conducted on occupational injuries occurring in 1975–1980 in Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Sri Lanka, and Thailand. The number of work accidents has risen rapidly during this period in all eight countries. In the case of Thailand, the total number of work injuries increased fourfold in 1975–1978; in Singapore it almost doubled in six years. The number of permanently disabled persons nearly trebled in Korea and the Philippines in 1967–1980. The largest percentage of accidents are loss-time injuries in all eight countries. Thailand had a threefold increase in loss-time injuries, while in Hong Kong the figure doubled. Six out of the eight countries indicated that the building construction industry had the largest number of fatal accidents, followed by the manufacturing industry.

Trends for work injuries and their costs in Canada

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The aim of this study is to demonstrate the magnitude of the work injury problem in terms of frequency and economic costs for the past decade (1971–1980) in Canada. Combining data from several sources, relevant tables are constructed in order to illustrate the descriptive epidemiology of the phenomena involved. All work injuries totalled 1,208,031 in 1980, an increase of 52 % over the decade. Disabling work injuries rose by 80.5 % in the same period, amounting to 46.8 % of all work injuries in 1980. Disabling work injuries per 100 employed workers grew by 37.4 % between 1971 and 1980. Only fatal work injuries showed a slight decline. The total direct and indirect costs stood at $\$318 \times 10^6$ in 1971 and swelled by 321 % over the 10 years. This amount constitutes 4.5 % of the total Canadian payroll and 2.3 % of the gross national product for the year 1980. Costs per accident and per employed worker rose by 176.6 % and by 217 % for the period studied. While some of these increases in money values may be attributed to inflation, the residue after the subtraction of price increases remains surprisingly high. In terms of a constant 1971 dollar, the total costs of work injuries more than doubled, costs per accident jumped by one-third, and costs per employed worker by over half. Thus, whether measured in terms of work injury frequency or costs, a persistent and worsening trend is observed.

MEDICAL SURVEILLANCE

On prerequisites for preventive intervention in the occupational context to avert health damages and impairments

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Following a discussion of various definitions of stress/strain and resulting model concepts, the author explicitly covers the checkup procedure practiced at the Hall Industrial Medicine Center. The person-environment relationship is viewed as a general basis of stress/strain in the occupational sphere, and in this connection a concept is advanced which is designated as P-E fit as in French et al. Of importance in this presentation is the differentiation between the objective and subjective work environment — ie, factors deriving from job responsibilities, work conditions, and other work-relevant criteria and how they are interpreted or redefined. Statistical coverage of the objective and subjective situation as a stress/strain characteristic complex is profiled and discussed. Special attention is devoted to the improved technical possibilities of compiling both stimuli from the work environment and physiological reactions of the employee throughout the duration of the entire work period. The long-term studies establish individual stress limits. An attempt to standardize occupational groups retroactively is made with the objective of preventing health hazards to the individual though selective job assignment. A study in an industrial plant serves as an example to illustrate the working of the individual-environment relationship.

Effects of intervention on cardiovascular mortality among workers exposed to carbon disulfide:

A 15-year follow-up

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The cardiovascular mortality of a cohort of 343 Finnish men exposed to carbon disulfide (CS_2) for at least five years in a viscose rayon plant has been monitored prospectively from 1967 to 1982. The results from the first five years of follow-up in 1972 showed a 4.7-fold excess mortality for ischemic and other heart diseases (International Classification of Diseases A83–A84) over that of a comparable reference cohort of papermill workers. During the next few years a preventive intervention program was carried out at the rayon plant, including removal of all those presenting coronary risk factors from exposure. Thus in 1977 only 19 % of the group was still in exposed work as against 53 % in 1972. Moreover exposure concentrations were reduced to comply with the set hygienic standard of 10 ppm from 1972 on. These measures evidently resulted in the normalization of the risk of cardiovascular death, for the relative risk was 1.0 in the period after the intervention (1 July 1974 through 30 June 1982) as opposed to 3.2 for the preceding time span (1 July 1967 through 30 June 1974). Yet the 15-year risk of a fatal heart attack remained 11.6 % (95 % confidence limits 8.5–15.4) for the exposed compared to 7.8 % (95 % confidence limits 5.3–11.2) for the nonexposed. The risk difference of 3.8 % was entirely accumulated during the first seven years of follow-up. This figure allows the estimation that, had there been no preventive action, altogether some 60 CS_2 -related cardiovascular deaths would have been observed in the latter eight-year period in lieu of the actually observed 19, the result showing a preventive fraction of 68 %.

OTHER PROBLEMS IN OCCUPATIONAL HEALTH

Work and pregnancy in Montreal — Preliminary findings

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Occupational factors as related to spontaneous abortion, prematurity, and congenital defects are being studied for most (> 90 %) pregnancies in Montreal, 1982–1984. Some 26,500 women were interviewed in the first year, ending in May 1983, regarding their current pregnancies and 24,000 previous pregnancies; the interview is expected to obtain data on some 100,000 pregnancies in all. Interviews of about 20–30 min cover work, personal habits, and social variables. The course and outcome of the pregnancies are obtained from hospital records. Exposure and ergonomic profiles are being developed for most types of work. Past pregnancies can be used to generate hypotheses for testing the better data for current pregnancies. Selected rates based on an analysis of the 5,461 first past pregnancies of 10,200 women are given in the table below. Similar findings will be presented for the 26,500 women interviewed in the first year.

	N	Ab- ort- ed (%)	Pre- ma- ture (%)	De- fect (%)
All first past pregnancies	5,461	17.7	6.0	4.4
Not at work in first month	1,812	16.9	6.5	4.0
At work in first month	3,649	18.0	5.8	4.6
In medical services	428	15.9	7.5	6.7
In certain other services	217	21.7	8.2	7.1
Work required				
Heavy lifting	199	23.6	7.2	4.6
Use of video display unit				
≥ 20 h/week	143	22.4	1.8	6.3
Piece work	85	23.5	3.1	4.6
Spouse employed in chemical industry	187	19.3	8.6	7.3

These crude rates should not be interpreted without the proper consideration of possible reporting bias and the role of confounding factors, issues to be discussed in the presentation. It is reassuring nevertheless that other analyses indicate that certain known associations (eg, with age and cigarette smoking) are demonstrable by the data.

Reproduction and exposure to lead

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A study on spontaneous abortion and twinning rate was carried out in a community with a lead smeltery and in a reference community without a specific source of lead exposure. For a period of 20 years (1961–1980) information on spontaneous abortions was recorded from vital statistics data. Data on twin deliveries were obtained from the birth certificates. The additional information regarding the weight of twins, maternal age of delivery, and mother's and father's occupations were recorded in an interview. To each twin birth two singleton births were matched by the area of

residence and date of birth. Pollution measurement data on lead, zinc, and cadmium were also evaluated. The average annual rate of spontaneous abortion in the community with a lead smeltery was 12/1,000 and in the reference community 6.7/1,000 fertile women. The cumulative rate of twin births was 2.7/1,000 inhabitants in the reference community. However, in the community with a lead smeltery, in the area actually exposed to lead, the cumulative rate of twin deliveries over 20 years was 1.6/1,000 inhabitants and in the rest of the community it was almost 3/1,000 inhabitants. The results indicate a possible interference of lead exposure with reproduction.

Reproductive outcomes in families of men exposed to 1,2-dibromo-3-chloropropane

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The families of 30 workers employed in a plant which, until 1977, had been producing 1,2-dibromo-3-chloropropane (DBCP) have been followed for five years. Thirteen men who were azospermic in 1977 had had over 100 h of exposure; four have recovered spermatogenesis and two have fathered four girls. Eight men who were oligospermic in 1977 had 34–95 h exposure; of eight children subsequently born to their wives, six were girls. Five men exposed between 10 and 60 h were normospermic in 1977 and subsequently fathered four boys and one girl. Wives of four non-exposed men and of exposed men prior to exposure bore 27 boys and 24 girls. No increase in spontaneous abortion occurred among wives of the exposed men. Four infant deaths and five congenital anomalies occurred among babies born of nonexposed pregnancies, but no infant or fetal deaths and no congenital abnormalities occurred among children born to wives of men who had been exposed. Children born to wives of exposed workers are all in good health and appear to have perfectly normal development. The birth of at least 10 girls out of 12 live births fathered by exposed workers could be expected, according to binomial probabilities, by chance with $p = 0.015$. The possibility that the observed female sex predominance could be related to Y chromosome nondisjunction reported to be more frequent in sperm of DBCP workers by Kapp et al is discussed. Conclusion: Some of the azospermic and oligospermic workers exposed to DBCP during its production recover normal spermatogenesis and father apparently healthy children, although there is an apparent predilection for girls. An apparent increase in spontaneous abortion, which we reported for applicators, who presumably had less exposure than production workers, was not found for pregnancies fathered by exposed production workers.

Congenital malformations, mortality and styrene exposure

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A Finnish cohort of 2,209 workers (1,698 men, 511 women) has been selected from the personnel files of 160 workplaces using styrene in the manufacture of reinforced polyester plastic products. About half of the workers have been ex-

posed to styrene for more than half of their daily work time. The earliest exposure began in 1960, but the majority of workers has been exposed after 1967. The number and time of birth of children born to the exposed workers were obtained from the Population Register. The data were linked with the data of the Register of Congenital Malformations held by the National Board of Health. Before the styrene exposure, the female workers had given birth to 346 children, two of whom had been notified to the malformation register (expected 4.4), and the male workers had had 771 children, four of whom had been notified to the register (expected 9.9). During the exposure, the women bore 79 children, one of whom was notified to the register (expected 1.5), and the men had 634 children, seven of whom were notified to the register (expected 9.5). There were 29 observed deaths in the cohort (expected 63.0) among the men and 8 (expected 11.0) among the women. The expected numbers were based on the national age- and sex-specific rates. Six of the deaths were due to cancer (expected 13.0). The cancer sites were stomach (2 cases), bronchus (1 case), breast (1 case), ovary (1 case), and kidney (1 case). There were no cases of lymphatic or hematopoietic system cancers. Most of the cancers appeared with short exposure times early after the commencement of work. The follow-up continues and several more years are needed before conclusions can be drawn on the possible cancer risk of this exposure.

Reproduction and male solvent exposure: A study of children of painters

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Previous investigations have indicated that occupational exposure to organic solvents could reduce male fertility and the quality of children. In order to test these observations, the present study has examined a group of male painters, who are regularly exposed to organic solvents, and electricians, who are not. The study hypotheses have been that painters had (i) reduced fertility, expressed as number of live-born children, (ii) increased risk of congenital malformations in children, (iii) increased risk of cancer in children, (iv) increased sex-ratio female : male for children as an index of risk of abortion, (v) increased prematurity and decreased birth weight and birth length of children, and (vi) increased infant mortality among children. The study is register-based with registration of outcome variables by record linkage between a number of registers. The source material was members of the National Union of Painters and the National Union of Electricians, in all 32,964 persons. By record linkage with the central personal register, children of these persons were recorded together with their vital status and sex; 32,337 children were registered. By record linkage with the National Cancer Register children with cancer were registered. By record linkage with the Death Certificate Register, the underlying cause of death was registered for children who had died. By record linkage with the Birth Register birth weight, birth length, and congenital malformations were registered. In the analyses various subpopulations were used to reduce the probability of bias due to deficiencies or misclassification in the recording of children in the central personal register. On the basis of the analysis of the data and the evaluation of possible bias due to registration deficits and misclassification, it is concluded that this study does not reveal significant differences between children of painters and children of electricians regarding (i) risk of congenital malformations, (ii) sex ratio female : male, which is taken to indicate no increased risk of abortions when the father is a painter, and (iii) risk of infant mor-

tality, neither in the first week, first month, nor first year. It is further concluded that children of painters are slightly smaller in weight and length at birth (but this tendency is not due to an increased rate of children of painters in the extremely low birth-weight groups associated with prematurity) and that children of painters have an increased frequency of childhood cancer (but this finding was not statistically significant and may be due to chance). The material was very sparse. Only 15 cases of cancer were recorded. Since the direction of the finding is in accordance with that found in other studies, this part of the study should be updated and reanalyzed in some years. Regarding fertility, the study cannot give any firm conclusions due to deficiencies in the recording of children in the central personal register. The effect of this deficiency could not be controlled in the analysis of fertility, but it is not considered to affect the other conclusions of the study.

Relationship between hypertension and sodium intake among metallurgic workers

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In a study of the relationship between sodium intake and the prevalence of hypertension among metallurgic workers, the levels of urinary electrolyte [sodium (Na), potassium (K), calcium (Ca) and chlorine (Cl)] excretion and the blood pressure of 310 male workers aged 35—59 years were measured in Tianjin in January 1982. The three-consecutive overnight mean of urinary sodium excretion in normotensives was 138.0 ± 48.81 mEq. It is equivalent to 408.89 mEq Na excretion and 23.92 gm salt of the mean 24-h output. The overnight Na : K ratio is 13.25. Both the Na excretion and Na : K ratio are higher than that in many regions of our country and other countries. Overnight urinary potassium excretion was 11.04 mEq, which is equivalent to 45.29 mEq K excretion of the mean 24-h output. It is lower than that in many regions in China. Urinary Na excretion in hypertensives was significantly higher than that of the normotensives. The levels of the urinary output of Na, Ca and Cl show a positive correlation with the blood pressure level. It is more likely that high Na, a high Na : K ratio, and low K in the diet is one of the most important factors responsible for the high prevalence of hypertension in Tianjin. There may be a synergistic effect of family history and Na intake on the prevalence of hypertension, but it does not reach the level of significance.

Hypertension: An oncoming health hazard in Nigerian workers

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The aim of the study was to prove the hypothesis that hypertension is a common health problem among Nigerian policemen. This study was part of a screening program known as "Operation Know Your Blood Pressure" currently in progress in cosmopolitan Benin. Blood pressure was recorded for 697 policemen aged 19—63 (mean 26.2) years and 530 male civil servants aged 19—62 (mean 28.4) years who acted as referents. Blood pressure was recorded on the right arm after the subject had been comfortably seated inside a bus for a least 5 min. An electronic sphygmomanometer with a

standard adult cuff was used. The mean of two cuff inflations was taken as the recorded blood pressure. One hundred and seventy-five civil servants (33.0 %) and 145 policemen (20.8 %) had blood pressures of $\geq 140/90$ mm Hg. The proportion of civil servants with high blood pressure was highly significant ($p < 0.001$). Forty-six civil servants (8.7 %) and 49 policemen (7.0 %) had a blood pressure of $\geq 165/95$ mm Hg; there was no significant statistical difference between the two groups. It is concluded that hypertension is a common health problem among Nigerian policemen and surprisingly more so among male civil servants. Poor conditions of service among the policemen and the irregularity and nonpayment of civil servants' salaries, which in recent times have been up to three months in arrears, are thought to be major contributory factors. The civil servants are state government staff, while the policemen are federal government staff.

Problems of industrial hygiene in the Nigerian textile industry: The Lagos metropolitan situation CO Cokanu — Environmental/Occupational Health Division, Federal Ministry of Health, Lagos, Nigeria

The purpose of this study was to highlight the problems of industrial hygiene and safety in the Nigerian textile industry. It should also serve as the first step in the preparation of a voluntary code of practice in this industry in Nigeria and as an educational paper for both the workers and the management in the industry. Out of the 48 factories in the area, 11 were selected for study. The 11 included big ($\geq 1,000$ workers), medium-sized (500–999 workers), and small (< 500 workers) factories. The survey was carried out in the Lagos metropolitan area. Most of the factories are located there. Most workers did not use the necessary safety devices, either because devices were not supplied or because the workers refused to use them. A dusty atmosphere was observed during the inspection. Noise levels were too high. Refuse was allowed to accumulate on open grounds. In some factories effluents were not treated before disposal into the public drainage system. Noise and heat were the most threatening factors.

An investigation of the adverse health effects of indoor air

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Energy efficiency considerations are leading to the design of an increasing number of sealed buildings that house both laboratories and offices. One such case is a federal government building which started operation in Ottawa in mid-1977. From the outset there were employee complaints ranging from simple eye irritation and noxious odors to more serious symptoms and abnormal laboratory findings, ie, elevated liver function tests, low white blood cell counts, etc. An alert occupational nurse also uncovered an apparent cluster of spontaneous abortions among office workers. A pilot survey of a 25 % sample of the employees in the building was conducted during December 1981. Multiple regression analysis showed that symptoms and absenteeism due to ill health, clustered among office workers, were more common among females and were inversely related to the degree of occupational exposure, a phenomenon indicating perhaps an increased susceptibility of the less exposed groups. A purposive subsample of annual examination

records revealed elevated liver function tests (on at least one occasion) in 45 % of the cases. The miscarriage rate among employees was 12.8 % before and 26.7 % after the building opened. Based on the pilot study, three different methodological approaches were evolved to address well-defined areas of concern (altered systems function, reproductive failures, long-term effects). These form the rationale for the full study involving approximately 2,000 federal public servants in four settings (the index building and three reference sites).

Chronic bilharziasis in Iraq and its effects on work M Ghaib, M Jaber — Department of Community Medicine, College of Medicine, University of Baghdad, Iraq

Bilharziasis (more commonly known as schistosomiasis) is one of the oldest diseases in Iraq, affecting vast areas in the middle and southern parts of the country. Tremendous progress in bilharziasis control has been achieved since 1968 as the incidence rate decreased from 6.2 % in 1970 to 1.56 % in 1980. However, many patients are presented with the complications of previous infestation(s). After the revolutions, the farmers started working harder than before in their fields, trying to improve their standard of living. Thus immigration to the cities became very common, and people started working in unfamiliar types of jobs which require continuous and regular body activity. Due to the fact that the symptoms of chronic bilharziasis become aggravated by fatigue and thirst, the new workers in physically heavy jobs started suffering again. A total of 1,520 patients were studied for a period of 15 years. The main presentations were bladder calcification, bladder ulcer, narrowing of one or both urethral orifices, lower end obstruction, and contracted bladder. A clinical examination, urine analysis, radiography, and cystoscopy were done to confirm the diagnosis. The clinical and laboratory findings are discussed.

Work-related illness experience among female clerical workers in a Hong Kong institution

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A cross-sectional survey of female clerks in the Chinese University of Hong Kong was conducted on the extent of work-related health complaints and associated factors. A random sample of clerks was drawn and interviewed with a uniform questionnaire on their health and fatigue experience and social and work circumstances. Self-reported illnesses ranged from 20 to 40 % of the sample, and one in every two workers reported work fatigue. Single clerks tended to report poorer health status and to experience more acute spells of illnesses and a higher rate of hospitalization than married clerks, though the difference was not significant. The demand of domestic duties and maternal responsibility seemed to increase the fatigue experience of married clerks compared with single clerks ($p < 0.05$). Married clerks reported increased difficulty in concentrating at work ($p < 0.05$) and more low-back pain ($p < 0.05$). The factors accounting for the different pattern of health and fatigue of these two groups of clerks is presented in detail and discussed.

The necessity for personal audit in coordinating an occupational health project

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Experience in initiating an occupational health organization for a major multinational company with plants situated throughout the Pacific area has demonstrated that flaws in the system are most likely to occur at the local level because of a misunderstanding of the reasons for central policy decisions. Personal audit of the most basic procedures will often highlight errors which have occurred originally due to faulty communication and are then perpetuated when ongoing professional supervision is lacking onsite. Personal explanation can usually correct these faults and, by elucidating the cause, will more than justify the time and effort spent discussing simple activities, a procedure which might not appear to be specifically part of the occupational health physicians' role as project administrator.

Lead exposure of children of battery workers

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This study was undertaken to determine whether children of lead battery workers were absorbing lead as a result of the father's occupation. Twenty-eight children of battery workers and 22 matched referents between the ages of one and four years were investigated with the use of the following indices: free erythrocyte protoporphyrin, hemoglobin, and packed cell volume. A smaller number of children were tested for blood lead. Environmental lead measurements were carried out both inside and outside each child's house and in each child's play area. The results indicated that the children of lead workers had a geometric mean concentration of free erythrocyte protoporphyrin that was almost twice as high as that of the referents. In the group of children whose blood lead level was measured, there was a correlation with their father's blood lead level. Household dust in the battery workers' houses contained a lead level that was more than three times higher than that measured in the referents' houses, but there was no difference in the lead levels in outside soil samples. It was concluded that children of battery workers had higher free erythrocyte protoporphyrin levels than matched referents and that the source of the lead was the fathers' workplace.

The contribution of occupationally related deaths to mortality in a selected cohort of aircrew members

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The purpose of this paper is to document the contribution of aviation accidents to a selected cohort of Royal Canadian Air Force aircrew followed from 1948 to 1978. This cohort

of 3,983 men was sealed in 1948 and has been followed with annual contact and with medical examinations at specified year intervals. As of 1978, only two of the cohort had been lost to follow-up. An analysis of the mortality experience of this cohort relative to the Canadian male population shows that the annual mortality has remained consistently lower than that of the Canadian male population with the exception of the years 1952 to 1958 when an excess mortality of six deaths was observed. By 1978 the cumulative mortality was 80 % of the expected with a mean annual observed over expected ratio of 0.72 for 1972:1978. Major cause-specific mortality rates are substantially lower than the general Canadian male population with the exception of "all accidents," which is nearly double that of the general population. An analysis of the 182 accidental deaths showed that 129 were due to aircraft accidents, a rare occurrence in the general population. If these occupationally-related deaths are removed, the observed to expected ratio for cumulative mortality was only 0.36 by 1958 and only 0.66 by 1978. The process of selection and self-selection into the Royal Canadian Air Force identified a cohort of healthy men. This cohort has maintained its comparative advantage to the general Canadian male population over 30 years in terms of mortality, despite an excess exposure to a high risk occupation.

Seasickness among the Republic of Singapore Navy personnel

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The incidence of seasickness in man varies, among other things, with the type, severity, and duration of the motion experienced, as well as with the susceptibility of the population selected. Reports of the incidence of seasickness ranged from 0.8 % on large ocean liners to almost 100 % in certain small combat landing crafts. The Republic of Singapore Navy deploys small fast gunboats which are very vulnerable to motion created by waves. Hence the prevalence of seasickness among the crew can be expected to be high. A cross-sectional study was conducted in April 1982 to determine the extent of the problem of seasickness in the Republic of Singapore Navy. A standard self-administered questionnaire was used to elicit their experience with seasickness. A total of 1,122 naval personnel were involved in the study — 75 % of them were found to have suffered from seasickness, 56.9 % had between 1 to 5 attacks, 12.5 % had between 6 to 10 attacks, and 30.6 % had more than 10 attacks. The majority of them were seasick by sea state 3 to 4. About half of them were severely affected as to be unable to continue with their normal duties. These findings are of great significance to us as we deploy small ships with limited crew where every crew member plays a very important role in the combat capability of our ships. The resulting disability from seasickness can be disastrous in combat situations. Fortunately most people sooner or later gain their "sea-legs" and settle down. We can certainly expect the same adaptation in our crew with greater sailing experience. In the meanwhile we are actively carrying out trials to determine the most effective anti-seasickness prophylaxis.

Health and social well-being in an isolated mining community

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Two concurrent studies are reported. The first is a cohort investigation, historically prospective (unique in Australian epidemiology), conducted within an industrial population which has congregated together in isolation, experiencing similar life-style risk factor exposures and specific occupational risks. The cohort consists of 3,300 executives, supervisors, and manual workers. The diseases of interest were chosen because they have either a life-style or an occupational etiology. The cohort is to be followed retrospectively for at least three years until the date of employment and then will be followed prospectively until 1 February 1987. The prevalence of morbidity and mortality in relation to the diseases of interest is to be recorded. Comparison of the prevalence of disease is to be made with the prevalence data from the Australian Health Survey and prevalence data from a smaller cohort of bus drivers in Brisbane. In the second study the social and demographic indicators of the community, in a wide range of parameters, were compared with those of other towns and cities. That comparison illustrated the effects which those community determinants of health may have on the prevalence of morbidity and mortality. This union of epidemiology, occupational health, and demography is a logical, orthodox, and natural method for analyzing the health risks inherent in life and work in an isolated, tropical, mining community in Northern Australia. The effects on the health and social well-being of the workers were concluded to be both positive and negative. A commentary on "healthy worker" and on "survivor population" effects is made. The special difficulties in follow-up are described. A number of techniques which overcome these difficulties in the Australian context are presented. Planning for future epidemiologic surveillance in equivalent industrial situations is suggested.

insulation, the production and use of asbestos-cement products, breaklining, clutch-facing, etc. A preliminary health examination was made on 280 male asbestos workers. Chronic cough was noted in 78 % of the workers. The prevalence of interstitial fibrosis, pleural thickening with effusion, and pleural plaques was 35, 3 and 27 %, respectively; no case of asbestos-related malignancy was found.

Occupational asthma in a steel coating plant

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Outbreaks of asthma at work present a challenge in determining their cause and extent. Two workers at a steel coating plant developed occupational asthma. The cause was obscure as the process used many potential sensitizing agents, and it was not clear if other workers were affected. A cross-sectional survey, including 221 of the 240 employees, showed that 21 fulfilled a questionnaire-based definition of occupational asthma, and 63 others had respiratory symptoms exacerbated by work. A comparison of the two groups showed that occupational asthma had developed only after 1971 and was confined to those exposed to coating line vapor. Inquiry of suppliers revealed that in 1971 toluene diisocyanate (TDI) had been introduced into a prime coat without the knowledge of the plant management. Both index cases had asthmatic reactions provoked by a TDI inhalation test. Serial records of peak expiratory flow rate demonstrated work-related asthma in 3 of 5 subjects with occupational asthma and 2 of 19 other subjects. Nine months later, when TDI had been removed from the process, no new cases of occupational asthma had developed, 85 % of the occupational asthma group reported loss or improvement of their symptoms, and none reported deterioration. Of those with other work-related respiratory symptoms, 57 % were asymptomatic or improved, and 11 % had deteriorated. Although there is room for much development in epidemiologic methods, surveys such as this can play an important part in the investigation of occupational asthma.

OCCUPATIONAL DISEASES OF THE RESPIRATORY SYSTEM

Occupational asbestos-related diseases in Taiwan

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It is known that occupational exposure to asbestos, especially white and green asbestos, may lead to so-called "asbestos-related diseases." Asbestosis or interstitial fibrosis of the lower zone of the lung, pleural thickening and pleural effusion, hyaline or calcified pleural plaques, mesothelioma of the pleura and peritoneum, bronchogenic carcinoma, and cancer of stomach or colon were all included. The annual consumption of asbestos in Taiwan is estimated to be about one million tons. The major sources are Canada, South Africa, and Australia, or recovery from shipbreaking. The kinds of asbestos used are chrysotile and crocidolite. A small amount of chrysotile, about 2–45 thousand tons a year, is mined and milled in the mountain area of Hwa-Lien, as a by-product of serpentine jadeite. More than one thousand laborers work with asbestos and its products in Taiwanese industries, including shipbuilding, shipbreaking,

A study of byssinosis in Hong Kong

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A survey using the standard respiratory questionnaire (modified for byssinosis) of the Medical Research Council and portable spirometers was carried out in six selected factories in the first six months of 1983. The factories were selected on the basis of the cotton dust level estimated within the previous six months. All workers in the blowing, carding and spinning departments were screened, and some clerical staff in the nondusty environment were also included in the study (a total of 1,780 subjects). The dust level of the factories ranged from 0.05 to 4.40 $\mu\text{g}/\text{m}^3$. Thirty-two (1.8 %) had typical symptoms of byssinosis. Two hundred and thirty-eight (13.4 %) had chest tightness and/or breathlessness but not specifically related to the first day of work after a 24-h workbreak. One hundred and eleven out of 1,024 (10.8 %) had a fall of greater than 10 % in their

forced expiratory volume in 1 s before and after work. Two hundred and thirty-five (13.2 %) had symptoms of chronic obstructive airway disease. The prevalence of byssinosis is relatively low in Hong Kong. The factors related to this finding are discussed.

Airway obstruction and solvents

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Obstructive airway diseases may be caused by irritative chemicals or toxic compounds. We observed 101 furniture painters and a reference group of 101 male workers of the furniture industry. Exposure to the mixture of solvents at the different workplaces was measured by personal air sampling. None of the single solvents of the different mixtures reached the individual maximum acceptable concentrations. Both groups were subdivided into smokers and nonsmokers. The lung function test included V, FVC₁, MVV, V, volume dependent resistance, and oscillatory resistance. Among the nonsmokers the furniture painters had a smaller MVV ($p < 0.05$), V ($p < 0.01$), and greater volume dependent resistance ($p < 0.01$) than the reference group. Among the smokers the furniture painters showed a smaller VC ($p < 0.05$) and a smaller volume dependent resistance ($p < 0.05$) than the reference group. The study shows that exposure to solvent mixtures at the maximum acceptable concentrations of the single compounds may cause airway obstruction.

Case-referent study on the lymphocyte functions of patients with asbestosis

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Lymphocyte functions associated with defense mechanisms of the body were investigated in textile workers exposed to asbestos. Thirty workers with asbestosis and sex-age matched referents were selected for the present study. The workers had a mean duration of 18 years since the first exposure to chrysotile. The asbestosis consisted of type 1 (9 workers), type 2 (19 workers), and type 3 (2 workers). Serum immunoglobulin (Ig) titers were determined by oucherlony and radioimmunoassay. Serum interferon titer was determined by the plaque reduction method with vesicular stomatitis virus and human fetal skin fibroblast. Killer and natural killer cell activity of peripheral blood mononuclear cells was evaluated against Chang liver cell and K562 cell, respectively. Serum Ig A, Ig G, Ig E, B₂-microglobulin, and interferon titers of asbestosis were significantly higher for the exposed workers than for the referents. Of these B₂-microglobulin titer increased with the advancedness of asbestosis. Killer and natural killer cell activity was slightly reduced in the asbestosis patients, but it was not significantly lower than in the referents. The correlation coefficient between serum interferon titer and natural killer cell activity was negatively significant for the asbestosis cases. In addition to immunologic abnormality, nonimmunologic abnormality was demonstrated for the asbestosis cases. These abnormalities might be related to the natural history of asbestosis.

Effects of low-level toluene diisocyanate exposure on respiratory systems

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A cross-sectional study was designed to clarify the dose-effect relationship between low-level toluene diisocyanate (TDI) exposure and its effects on respiratory systems. The pulmonary functions of 76 male TDI-exposed and 42 male nonexposed workers were examined by the forced expiratory flow volume test and the measurement of respiratory resistance and impedance. During the same period of study, the pulmonary functions of an additional 100 male workers who had been free of exposure to toxic substances were measured by the same examiners using the same instruments, and their data were used to obtain a prediction equation for age and height adjustment and to evaluate the validity of the nonexposed workers as a referent population. The means of the time-weighted average exposure concentrations of TDI were 0.0051 ppm for the higher exposed group ($N = 66$) and 0.0012 ppm for the lower exposed group ($N = 63$). Short-term high exposure at 0.02 ppm or higher was observed in 13 samples of the higher exposed group and in 3 samples of the lower exposed group. No significant differences in the pulmonary functions and the day-shift changes of the pulmonary functions were found between the TDI workers and the nonexposed workers. Similarly no differences were detected between the workers in the higher exposed group and those in the lower exposed group. Twenty-three of the 76 TDI workers had a history of respiratory trouble induced by working in the foam factories, but no decline was found in their pulmonary functions. These results suggest that TDI exposure at or below the level of this study may not induce adverse effects on the respiratory system of the current TDI workers who have no respiratory trouble.

Health effects of rice-husk dust on Malaysia ricemill workers

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In many Asian countries, including Malaysia, rice forms the staple food of the native populations and is a major agricultural crop in these areas. After harvesting, the processing of rice includes milling, which generates a large amount of dust. There has been little research done on the health effects of rice-husk dust. Thus an epidemiologic study was carried out to determine its effects on Malaysian ricemill workers. The study population consisted of 129 male workers from three rice mills, with 40 referents of the same age, sex, ethnic group, and socioeconomic background. Interviews using standardized questionnaires, a physical examination, total and differential white cell counts, chest radiographs, and lung function tests were performed on each of the exposed workers and the referents. Environmental dust monitoring was also carried out in the three rice mills. A preliminary analysis of the results showed that the health effects include chronic eye irritation with pterygium formation, respiratory symptoms such as cough, sputum, rhinitis

and throat irritation, and pruritus of exposed skin areas. The eosinophilic white counts also appeared to be raised.

Cross-sectional study on chronic respiratory disease among farmers

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A total of 2,932 farmers (90.9 % response rate) was studied in an attempt to ascertain the prevalence of respiratory disease and the various associated factors. A 10 % random sample of this population was then compared with a sample of tradesmen and clerks living in the same area. A questionnaire was used to obtain information about respiratory symptoms and various risk factors, a chest radiograph was taken, and forced expiratory volume in 1 s ($FEV_{1.0}$) and forced vital capacity were measured. After the first screening the transfer of carbon monoxide, allergic skin tests, and precipitin tests of the sera were performed. Chronic bronchitis was significantly more frequent among the farmers than among the referents (9.9 vs 4.8 %). The prevalence of bronchial asthma was similar in both groups (2.8 and 2.4 %). The $FEV_{1.0}$ was lower among the farmers. The prevalence of farmer's lung was 1.4 % for the farmers, whereas no such disease was found in the reference group. The risk of chronic respiratory disease appeared important only on small farms and in traditional stables, linked to a farming method that is being replaced.

Disappearing workers in dust operations

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An epidemiologic study on 176 dust workers from various facilities was initiated in 1978. Their mean age was 48.3 years, and the mean duration of employment was 21.6 years. None of the workers complained of chronic cough and phlegm. Their chest radiographs were found to belong to category I of the diagnostic criteria for pneumoconiosis in Japan. Spirometry was performed on this population; however, 54 workers had dropped out of the observation by the end of 1979, and 49 workers had disappeared by 1981. A total of 73 dust workers had a five-year follow-up of pulmonary function. The workers were grouped into the following three categories: 54 early disappearing workers with the mean age of 51.5 years, 49 late disappearing workers with the mean age of 47.3 years, and 73 active dust workers with the mean age of 46.8 years. Forced expiratory volume in 1 s divided by forced vital capacity ($FEV_{1.0}/FVC$) and forced expiratory flow rate at 25 % of the FVC divided by height (V_{25}/H) in 1978 were compared among the three groups. Screening levels of these variables according to the worker's age, obtained from the Japanese standard population, were used for the calculation of the individual percentage of the predicted pulmonary function values. An increase in the mean percentage of the predicted $FEV_{1.0}/FVC$ and V_{25}/H was shown for the 73 workers who had a five-year follow-up of pulmonary function. The mean values of these functional parameters were lower in the early disappearing group than in the late disappearing group. The active group was considered a "survivor" population. Decrements of $FEV_{1.0}/FVC$ and V_{25}/H in the longitudinal five-year follow-up group were larger than those of the Japanese standard population.