Scientifically Speaking

Hazards at work

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Washington, DC—Complicated questions of genetic make-up and screening procedures, reproductive biology and teratology, toxicity thresholds and carcinogenicity are moving from the laboratory to the factory workplace. Because of that, the same questions are commanding the attention of government agencies whose concern is the labour force, also the labour unions, and the usual groups that coalesce around newly discovered "rights." Some of the issues already have been pushed into the law courts and many more probably will be. The profitability of great industrial firms may be strongly affected by such matters as the benzene exposure required to break chromosomes in an otherwise apparently intact man or woman. Topics such as sickle-cell trait, chromosomal translocations, and sperm counts are increasingly important in the parlance of industry. A top official of the Oil, Chemical, and Atomic Workers International Union foresees the 1980s as a "decade of genetic confrontation" over workers' allelic fitness to hold particular jobs.

Women at risk

Much of the recrimination and bureaucratic intervention that has been expended thus far on these concerns began with women workers being excluded from some jobs for fear that toxic material might damage the embryo if they became pregnant. Since the teratogenic potential of many workplace chemicals is greatest in very early pregnancy, when a woman might not know that she had conceived, some firms simply precluded the employment of fertile women in jobs with a known risk of exposure to certain substances.

In at least one factory—claimed the US Occupational Safety and Health Administration—that policy led women to have themselves sterilised so they could keep their jobs. They were working with lead chromate pigments, and lead is widely regarded as posing particular toxicity for the fetus. The government agency which enforces a law against workplace environments that threaten death or serious physical harm to the worker contended that the sterilisation constituted job-related physical harm. The case appears to be heading for litigation. There are several other potential lawsuits around the country concerning women who were moved from jobs because they were capable of becoming pregnant. Yet major chemical manufacturers, surveyed by a publication of the American Chemical Society, uniformly stated that their policies would be to keep women out of areas containing materials of known fetotoxicity, whether or not the women were pregnant.¹ The sex discrimination aspect of workplace hazards may be somewhat reduced in importance

if some newly proposed government regulations come into force. The regulations would allow only temporary exclusion of workers according to sex from a particular job—and would make the company responsible for conducting animal studies to prove, within two years, that the hazard on that job indeed affects only the excluded sex.

Manufacturers, labour unions, and government agencies place different emphasis on who should be most protected from the hazardous substances of the workplace. Industry's health experts express most concern over the possibility of fetal damage, having taken as their lesson such examples as thalidomide, which is a teratogen in amounts that do not have discernible adverse effects on adults. The fetus, industry also is aware, occupies a special legal niche if it is harmed: it did not agree to be exposed to the hazards of whatever job its mother held. Hence the fetus is not covered by workers' injury compensation programmes, and, as shown in lawsuits over teratogens, a malformed child poses a staggering liability for the firm proved to have harmed it. Labour unions tend to emphasise risk to the worker, regardless of sex, and view gender-related manipulations of the workforce as company attempts to evade responsibility for reducing the hazards of the job. Government agencies are moving toward labour's outlook and away from their former principal concern with hazards to women of reproductive capacity.

These, however, are straightforward matters of workplace toxicity for the average egg, sperm, or fetus. They do not begin to generate the apprehension implied by that labour official's forecast of "genetic confrontation" between companies and workers. There are two components to the worries about the future of genetics in the workplace. One is that some worker injuries will be linked to particular genetic make-ups that render the worker more susceptible to the injury; this is the blame-the-victim circumstance. The other is that screening techniques will be developed and used to detect just such genetic susceptibilities to injury, on which finding the person at risk will be denied employment or taken off the job. In either case, the onus is on the person rather than the hazardous nature of the job.

Genetic screening

A recent newspaper survey² of major firms in the petrochemical industry found that companies do conduct genetic investigations of some employees and some job applicants. There is no solid evidence that the investigations have produced results that have been acted on, but the entire enterprise tends to have a cast of uneasiness in its possibilities for the future. A major chemical company gives blood tests to all blacks applying for jobs and examines the samples for sickle-cell trait. The heterozygous condition carries no provable greater risk of incapacity, but one possible inference is that the person might wish to stay away from the strongly oxidant compounds that can cause haemolytic anaemia. Such would be the case for people with glucose-6-phosphate dehydrogenase deficiency, whose haemolytic reactions to the fava bean also may be triggered by

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exposure to nitrofurantoin, naphthalene, and kindred compounds. If the sickling trait can be imagined as important for workers in the chemical industry, so also would the heterozygotes for the thalassaemias. And, to throw the racial and ethnic net even wider, how about screening for α_1 -antitrypsin deficiency, with its high incidence among Scandinavians? Association of that deficiency with pulmonary emphysema is a natural for workers in fume-permeated factories. The newspaper survey in fact discovered that one chemical firm does check serum samples for α_1 -antitrypsin as part of a pre-employment examination.

If one is imputing Orwellian overtones to the possibilities of screening for disease susceptibilities in the workplace, it is only a small conceptual hop to imagine genetic screening for the increased likelihood of any frailty. Over 50 diseases are definitely associated with particular HLA antigens. Would a factory hire as a labourer a man with antigen B27, known to be a hundredfold more likely to develop ankylosing spondylitis? Conceivably not if there was a chance that the man would blame his bad back on the strain of work. Of the diseases that would seem likely to be evoked by the industrial environment from gene-linked diathesis, cancer probably leads the list. Thus far only three kinds of cancer are associated with identifiable genetic abnormalities—renal clear-cell carcinoma, Wilms's tumour, and retinoblastoma—but the possibilities seem endless. The nudge that industrial substances imaginably could give to a genetic predisposition for malignancy has a high index of suspicion.

A recent round-up of investigations that might lead to genetic assays for cancer susceptibility³ indicates that much may be learnt from conditions such as ataxiatelangiectasia, also known as Louis-Bar syndrome. The syndrome, probably autosomal recessive in inheritance, displays both ataxia and telangiectasia, but became interesting to investigators in the 1960s principally because of the immunodeficiencies found with it. More recently, Louis-Bar syndrome has come to be recognised as carrying a greatly increased risk of malignant tumours, many in purely lymphoreticular sites, but some also developing in ovary, breast, and gall bladder. Patients with the Louis-Bar syndrome are extremely sensitive to ionising radiation. So are their cultured cells, which also succumb readily to chemicals whose damaging effects are similar to those of radiation. Cells cultured from close

kin of Louis-Bar patients are more sensitive to radiation and chemicals than are cells cultured from the general public. At present several laboratory groups are looking at cells from relatives of patients with cancer, gauging the susceptibility of those cells to radiation or certain chemicals, and beginning to make tentative predictions about degrees of cancer diathesis. The implications for employment of people from such bloodlines in, for instance, nuclear electricity generating plants, seems obvious.

Another tack in probing for cancer susceptibility is measuring the likelihood of mutation of DNA exposed to toxic substances. A test has been developed to detect damage to a gene on the X chromosome that codes for hypoxanthine-guanine phosphoribosyl transferase (HGPRT). It's not that HGPRT necessarily has anything to do with cancer (although its deficiency does cause the appalling Lesch-Nyhan syndrome), but simply that if the genes that code for it are made to mutate, cells with mutant genes can grow in cultures that would kill normal cells. Still to be determined is whether persons whose white cells show HGPRT mutations are more likely to develop cancer. That work is under way.

If these or other tests do detect the people most susceptible to cancer, it is hard to imagine an industry dealing with carcinogens not availing itself of the screen. It is even harder to imagine an insurance company not wishing to adjust its rates according to blood tests.

In general, the subtle physiological damage of the work place has a long latency. The malignancies caused by working with chemicals less strident than vinyl chloride are believed to become obvious only near the end of a worker's productive life. It has already been suggested that jobs of great hazard from their environmental exposures be given to older workers—those who would not normally live long enough to show the damage.

References

- 1 Rawls RL. Reproductive hazards in the workplace. *Chemical Engineering News* 1980 February 11 and 18.
- 2 Severo R. The genetic barrier. *The New York Times* 1980 February 3-6.
- 3 Kolata GB. Testing for cancer risk. *Science* 1980 February 29.

What is the treatment for an elderly fit man diagnosed as having dry eyes (seven years after a successful cataract operation)? There is a continuous feeling of foreign bodies in the eyes.

Dry eyes are due to reduced lacrimal secretion, which may result from disease of the lacrimal gland or of the conjunctiva, but in the elderly more often results from a spontaneous reduction in secretion. This produces drying of the precorneal tear film, with resultant damage to the corneal epithelium in the form of punctate epithelial erosions, which cause the irritation. The precorneal drying may be aggravated by a low blink rate in the elderly and exposure to dry heat sources, such as gas and electric fires. Exposure due to poor apposition to the eyes of the eyelids, or to poor eyelid closure in sleep may sometimes contribute. It is not likely that this patient's previous surgery for cataract plays any part. Apart from avoiding conditions that dry the eye, the treatment is to enhance the tear film with eye drops. Methylcellulose drops were formerly used, but these have been superseded by hydroxypropyl methylcellulose 1% (hypromellose BPC) which has better mechanical properties. Eye drops containing additionally dextran 70 (tears naturale) may have even better properties and are preferred by some patients. These drops are without side effects and should be used with the frequency that the patient finds most comfortable. In severe cases the adhesion of mucus to the cornea with the formation of epithelial filaments may cause severe discomfort. Mucolytic eye drops, acetylcysteine 10% to 20%, used two to four times a day may help. Permanent occlusion of the lacrimal puncta by electrocautery under local anaesthetic should also be considered. This will prevent the normal drainage of

tears. Before this is done, it is wise to make a temporary occlusion by inserting small gelatin rods into the puncta, and permanent occlusion is best avoided if the temporary occlusion causes epiphora.

It has been said that only polyunsaturated fatty acids are useful in diets to help reduce cholesterol levels and that mono-unsaturated fatty acids (as in olive oil) are of no use. Is there evidence to support this view?

This is a very limited view of the role of fatty acids in atherosclerosis and coronary heart disease. It almost certainly arises from the established fact that polyunsaturated fatty acids tend to lower blood cholesterol concentrations, saturated fatty acids tend to raise them, and the mono-unsaturated fatty acids are relatively neutral in this respect. All the international and national committees issuing recommendations on the prevention of coronary heart disease, however, agree that the critical factor is a substantial reduction in the intake and proportion of saturated fatty acids. As we are a community used to a high fat intake, partial substitution of the removed saturated fatty acids by polyunsaturated fatty acids has been recommended by several committees, including the Royal College of Physicians and the British Cardiac Society (1976). The use of mono-unsaturated fatty acids, however, such as olive oil, is also to be preferred to saturated fatty acids, and while they may not be as effective in lowering the blood cholesterol as polyunsaturated fatty acids, their use should be recommended. The low coronary heart disease rates in the Mediterranean regions and the quality of their cuisine would lead me to approve strongly of olive oil in the diet.