

THE LANCET

Vinyl Chloride, P.V.C., and Cancer

At the end of 1972 a man of 71 died in the Victoria Hospital, Blackpool, from a rare form of neoplasia, angiosarcoma of the liver. He had worked for 20 years as a process worker making polyvinyl chloride (P.V.C.) from vinyl chloride (V.C.). The details of the case are given by Dr LEE and Dr HARRY on p. 1316: according to them, this is the nineteenth case of its kind, though the first in the United Kingdom. Cases of hepatic angiosarcoma in men exposed to V.C. have been previously reported in the United States of America,¹ Sweden, and Germany.

The reaction of experimentalists to the situation is to ask why nobody heeded the results of work on rats, published in 1971. VIOLLO and his colleagues² reported the occurrence of cancers which were later found to have arisen in the acoustic duct, and cancers of the lungs, bones, and other sites in 17 out of 25 rats exposed to 30,000 p.p.m. V.C. for 20 hours a week. The answer may be that, in some eyes, experimentalists have too often cried "cancer-wolf" on quite inadequate evidence of real hazard. In any case it could have been argued that 30,000 p.p.m. is very high in comparison with human exposure levels to V.C. in most P.V.C.-manufacturing plants in 1971. The reaction of the Department of Employment Factory Inspectorate has been to set a new interim upper limit for exposure to V.C. in P.V.C. manufacturing plants at 50 p.p.m. with a maximum time-weighted average exposure of 25 p.p.m. However, these limits will almost certainly be lowered in view of CESARE MALTONI's claim to have produced angiosarcomas of the liver by exposing rats to only 50 p.p.m. V.C. (reported on May 10 at a meeting organised by the American Cancer Society and New York Academy of Sciences). The reaction of the manufacturers, through the Chemical Industries Association Ltd., has been to pool their experience and resources in the production of a guidance document for P.V.C. processors.³ There is no indication that P.V.C. is itself dangerous or that it depoly-

merises to produce V.C. But unreacted V.C. which is present in newly manufactured P.V.C. may be released during storage and when the material is heated during manufacture of P.V.C. products. Compounding processes known as dry blending, Banbury/2 roll mill compounding, extrusion compounding, and paste mixing, and fabrication processes such as extrusion, calendaring, and paste spreading may be associated with release of V.C. into the atmosphere. Carefully planned ventilation at appropriate points in P.V.C. processing plants is therefore recommended. The reaction of food-packaging experts is still awaited. By the time P.V.C. sheeting is used for wrapping food its V.C. content is probably low and very little may find its way into food or into the atmosphere of the food supermarket or domestic kitchen. Nevertheless, information is needed. At the very least the public should be told—if it is true—that the grades of P.V.C. used for wrapping food are pretreated to remove as much free V.C. monomer as possible.

To date, all those workers who have developed angiosarcoma of the liver have a history of intermittently heavy exposure to V.C. over periods of from 12 to 27 years in P.V.C.-manufacturing plants. There have been no cases among P.V.C. processors. Most examples of heavy exposure date back to the early days of P.V.C. manufacture before certain other, non-cancerous, health hazards associated with exposure to V.C. were recognised. Raynaud's phenomenon (acro-osteolitis) in response to V.C. was reported as early as 1957⁴⁻⁶; more lately, chronic liver poisoning leading to portal obstruction, bleeding from oesophageal veins, and splenic enlargement were identified as V.C. effects. Their discovery led to ever-increasing efforts to protect workers from exposure to V.C. Nobody knows how many more cases of V.C.-induced angiosarcoma of the liver will come to light. Optimists will argue that the conditions in industry have so greatly improved that we may already have seen the worst. Pessimists, however, will say that we have so far probably seen only those cases with the shortest latent interval resulting from the heaviest exposure, and that an epidemic of cases with longer latent intervals associated with lesser exposure is yet to come. Moreover, an effect of V.C. on the incidence of certain less rare forms of cancer may so far have passed unnoticed. Whatever happens, the V.C. episode will have provided a salutary lesson. It will not be quite so easy in the future, as it has been in the past, for any chemical manufacturer to assume, until proved otherwise, that a chemical to which workers are exposed is carcinogenically safe. There must surely be more sys-

1. Gray, B. J., L. Johnson, M. N. *J. Occup. Med.* 1974, 10, 130.

2. Viollo, P. L., B. R. Caputo, A. Caputo, A. *Cancer Res.* 1971, 31, 516.

3. Vinyl Chloride Monomer: Advisory Note for the Guidance of PVC Processors. Published by Chemical Industries Association Ltd., Atlantic House, 93 Albert Embankment, London SE1 7TU, June 12, 1974.

4. Lester, D., Greenberg, L. A., Adams, W. R. *Am. Ind. Hyg. Ass. J.* 1963, 24, 265.

5. Lange, C. E., Jühe, S., Stein, G., Veltman, G. *Int. Arch. Arbeitsmed.* 1974, 32, 1.

6. Jühe, S., Lange, C. E., Stein, G., Veltman, G. *Dr. med. Wschr.* 1974, 98, 2034.

1324

tematic evaluation of industrially used chemicals for carcinogenic risk to workers. In its own area, the thalidomide disaster was a milestone. Vinyl-chloride angiosarcoma is a milestone in occupational hygiene.