

from Eastern Kentucky University, Richmond, Ky., in 1951, a master of science in zoology from Cincinnati in 1954, and doctor of philosophy from the school in 1958, concentrating in physiology, ecology, and biochemistry.

Enforcement

OSAHRC RULES FAILURE TO MONITOR FOR VINYL CHLORIDE IS JUSTIFIED

A manufacturer's belief that only a "negligible" amount of vinyl chloride (VC) would be released during an operation in which polyvinyl chloride (PVC) was used is seen to justify the firm's decision not to monitor the operation for VC.

This 2 to 1 ruling of the Occupational Safety and Health Review Commission in *Western Electric, Inc.* (No. 8902) reversed a decision of Review Commission Judge Paul E. Dixon.

Western Electric was cited for allegedly failing to monitor an operation in which a solution containing PVC was used in a process whereby wire coils are coated with a layer of insulation. The company's omission was alleged to be in violation of the monitoring requirement of the emergency temporary standard for vinyl chloride, 29 CFR 1910.93q(c)(1).

The employer's contention that VC was not "released" during the coating process within the meaning of the standard was based on monitoring performed by one of the firm's industrial hygienists at its Lee's Summit, Mo., plant. The operation monitored was one in which sheets of PVC are welded together to make exhaust ducts. The hygienist thought that, of all the operations in the plant utilizing PVC, this would result in the release of the greatest amount of VC. The resulting measurement of several parts per billion reinforced his conclusion that VC levels in all areas of the plant were well below the 50 ppm specified in the emergency standard. Accordingly, he decided it was unnecessary to monitor the other operations in which PVC is used.

The highest concentration of VC measured by the Secretary of Labor was 1.7 ppm, or approximately one-thirtieth of the 50 ppm limit established by the standard. Nevertheless, the secretary argued that because some amount of VC, however small, is "released," Western Electric violated the standard by failing to monitor the coil coating operation. On the other hand, the employer contended that the standard was not intended to require monitoring when only a negligible amount of VC is released in an operation utilizing PVC.

Noting that Western Electric's decision not to monitor the coil coating process was based on foresight, the commission majority declined to find a violation of the standard. The result of the company's monitoring of the welding operation, coupled with its understanding of the process by which VC is released from PVC, strongly suggested that the amount of VC released in the coil coating operation would be negligible compared with 50 ppm, according to the majority. "Nothing in the record casts doubt on the validity of this judgment, or on the good faith with which it was made," the majority added in an opinion written by Chairman Frank R. Barnako. Commissioner Robert D. Moran concurred.

In the dissenting opinion of commission member Timothy F. Cleary, the standard requires monitoring of employee exposure levels in every operation in which any vinyl chloride is released. In his opinion, the majority has substituted its own monitoring standard. Since some quantity of VC was released into the work environment during the coating

operation and the operation was not monitored by Western Electric, Cleary would affirm the citation.

This ruling will appear in a future Decisions supplement.

Appropriations

REVIEW COMMISSION JUSTIFIES '78 REQUEST IN BUDGET FOR \$720,000 OVER '77 BASE

The Occupational Safety and Health Review Commission February 3 justified a \$720,000 increase in its budget request for fiscal 1978 amounting to a total of \$7,150,000, to the House Appropriations Labor-Health, Education, and Welfare Subcommittee.

The increase includes \$316,000 for employment of five additional administrative law judges, four clerical support positions for the ALJ's, one appellate counsel, and one secretarial position. The increases also include a \$150,000 supplemental request to support the FY 1977 pay raise.

In addition, other increases include \$108,000 to cover costs of converting from a commercial contractor for automatic data processing services to a commission-operated mini-computer system.

Review Commission Chairman Frank R. Barnako was requested by Congressman Silvio O. Conte (R-Mass) to answer for the record the following questions:

- ▶ How many cases has your commission successfully handled in the past year?
- ▶ Do you see a possible trend evolving toward an increase in this number as a result of the adoption of Rule 91a?
- ▶ Did you see any need to revise your budget requests since the adoption of Rule 91a?
- ▶ At what rate is your work load increasing every year?
- ▶ With the closing of field offices on the west coast how much will your case load decrease? What are the monetary savings?
- ▶ Will the combination of your extensive reorganization and congressional acceptance of your budget allow you to handle your case load efficiently?
- ▶ Where will these proposed new Administrative Law Judges be located?
- ▶ What is the price tag attached to your computerized retrieval and case tracking system?
- ▶ What are the unnecessary services you referred to which are provided by the G.S.A. and how much do they cost the commission?
- ▶ Do you know what the savings would be if you moved out of Washington D.C. and into the metropolitan area?
- ▶ What are the estimated savings in time and money related to the recent adoption of Rule 91a?

ASI 00022793

Utah

OSH ACT IS UNCONSTITUTIONAL, STATE DISTRICT COURT JUDGE RULES

The Utah Occupational Safety and Health Act violates the state constitution in several respects, a state court judge held on January 19.

Judge Bryant H. Croft of the District Court of the Third Judicial District, Salt Lake County, issued this ruling in a class action titled *Baird v. State of Utah* (Civil No. 237878).

Plaintiff R. Lamar Baird, a local businessman, filed suit on behalf of himself and all other Utah residents similarly situated, seeking an injunction against the enforcement of the state job safety law, which is modeled after the federal

from Eastern Kentucky University, Richmond, Ky., in 1951, a master of science in zoology from Cincinnati in 1954, and doctor of philosophy from the school in 1958, concentrating in physiology, ecology, and biochemistry.

Enforcement

OSAHRC RULES FAILURE TO MONITOR FOR VINYL CHLORIDE IS JUSTIFIED

A manufacturer's belief that only a "negligible" amount of vinyl chloride (VC) would be released during an operation in which polyvinyl chloride (PVC) was used is seen to justify the firm's decision not to monitor the operation for VC.

This 2 to 1 ruling of the Occupational Safety and Health Review Commission in *Western Electric, Inc.* (No. 8902) reversed a decision of Review Commission Judge Paul E. Dixon.

Western Electric was cited for allegedly failing to monitor an operation in which a solution containing PVC was used in a process whereby wire coils are coated with a layer of insulation. The company's omission was alleged to be in violation of the monitoring requirement of the emergency temporary standard for vinyl chloride, 29 CFR 1910.93q(c)(1).

The employer's contention that VC was not "released" during the coating process within the meaning of the standard was based on monitoring performed by one of the firm's industrial hygienists at its Lee's Summit, Mo., plant. The operation monitored was one in which sheets of PVC are welded together to make exhaust ducts. The hygienist thought that, of all the operations in the plant utilizing PVC, this would result in the release of the greatest amount of VC. The resulting measurement of several parts per billion reinforced his conclusion that VC levels in all areas of the plant were well below the 50 ppm specified in the emergency standard. Accordingly, he decided it was unnecessary to monitor the other operations in which PVC is used.

The highest concentration of VC measured by the Secretary of Labor was 1.7 ppm, or approximately one-thirtieth of the 50 ppm limit established by the standard. Nevertheless, the secretary argued that because some amount of VC, however small, is "released," Western Electric violated the standard by failing to monitor the coil coating operation. On the other hand, the employer contended that the standard was not intended to require monitoring when only a negligible amount of VC is released in an operation utilizing PVC.

Noting that Western Electric's decision not to monitor the coil coating process was based on foresight, the commission majority declined to find a violation of the standard. The result of the company's monitoring of the welding operation, coupled with its understanding of the process by which VC is released from PVC, strongly suggested that the amount of VC released in the coil coating operation would be negligible compared with 50 ppm, according to the majority. "Nothing in the record casts doubt on the validity of this judgment, or on the good faith with which it was made," the majority added in an opinion written by Chairman Frank R. Barnako. Commissioner Robert D. Moran concurred.

In the dissenting opinion of commission member Timothy F. Cleary, the standard requires monitoring of employee exposure levels in every operation in which any vinyl chloride is released. In his opinion, the majority has substituted its own monitoring standard. Since some quantity of VC was released into the work environment during the coating

operation and the operation was not monitored by Western Electric, Cleary would affirm the citation.

This ruling will appear in a future Decisions supplement.

Appropriations

REVIEW COMMISSION JUSTIFIES '78 REQUEST IN BUDGET FOR \$720,000 OVER '77 BASE

The Occupational Safety and Health Review Commission February 3 justified a \$720,000 increase in its budget request for fiscal 1978 amounting to a total of \$7,150,000, to the House Appropriations Labor-Health, Education, and Welfare Subcommittee.

The increase includes \$316,000 for employment of five additional administrative law judges, four clerical support positions for the ALJ's, one appellate counsel, and one secretarial position. The increases also include a \$150,000 supplemental request to support the FY 1977 pay raise.

In addition, other increases include \$108,000 to cover costs of converting from a commercial contractor for automatic data processing services to a commission-operated mini-computer system.

Review Commission Chairman Frank R. Barnako was requested by Congressman Silvio O. Conte (R-Mass) to answer for the record the following questions:

- How many cases has your commission successfully handled in the past year?
- Do you see a possible trend evolving toward an increase in this number as a result of the adoption of Rule 91a?
- Did you see any need to revise your budget requests since the adoption of Rule 91a?
- At what rate is your work load increasing every year?
- With the closing of field offices on the west coast how much will your case load decrease? What are the monetary savings?
- Will the combination of your extensive reorganization and congressional acceptance of your budget allow you to handle your case load efficiently?
- Where will these proposed new Administrative Law Judges be located?
- What is the price tag attached to your computerized retrieval and case tracking system?
- What are the unnecessary services you referred to which are provided by the G.S.A. and how much do they cost the commission?
- Do you know what the savings would be if you moved out of Washington D.C. and into the metropolitan area?
- What are the estimated savings in time and money related to the recent adoption of Rule 91a?

ASI 00022794

Utah

OSH ACT IS UNCONSTITUTIONAL, STATE DISTRICT COURT JUDGE RULES

The Utah Occupational Safety and Health Act violates the state constitution in several respects, a state court judge held on January 19.

Judge Bryant H. Croft of the District Court of the Third Judicial District, Salt Lake County, issued this ruling in a class action titled *Baird v. State of Utah* (Civil No. 237878).

Plaintiff R. Lamar Baird, a local businessman, filed suit on behalf of himself and all other Utah residents similarly situated, seeking an injunction against the enforcement of the state job safety law, which is modeled after the federal

from Eastern Kentucky University, Richmond, Ky., in 1951, a master of science in zoology from Cincinnati in 1954, and doctor of philosophy from the school in 1958, concentrating in physiology, ecology, and biochemistry.

Enforcement

OSAHRC RULES FAILURE TO MONITOR FOR VINYL CHLORIDE IS JUSTIFIED

A manufacturer's belief that only a "negligible" amount of vinyl chloride (VC) would be released during an operation in which polyvinyl chloride (PVC) was used is seen to justify the firm's decision not to monitor the operation for VC.

This 2 to 1 ruling of the Occupational Safety and Health Review Commission in *Western Electric, Inc.* (No. 8902) reversed a decision of Review Commission Judge Paul E. Dixon.

Western Electric was cited for allegedly failing to monitor an operation in which a solution containing PVC was used in a process whereby wire coils are coated with a layer of insulation. The company's omission was alleged to be in violation of the monitoring requirement of the emergency temporary standard for vinyl chloride, 29 CFR 1910.93q(c)(1).

The employer's contention that VC was not "released" during the coating process within the meaning of the standard was based on monitoring performed by one of the firm's industrial hygienists at its Lee's Summit, Mo., plant. The operation monitored was one in which sheets of PVC are welded together to make exhaust ducts. The hygienist thought that, of all the operations in the plant utilizing PVC, this would result in the release of the greatest amount of VC. The resulting measurement of several parts per billion reinforced his conclusion that VC levels in all areas of the plant were well below the 50 ppm specified in the emergency standard. Accordingly, he decided it was unnecessary to monitor the other operations in which PVC is used.

The highest concentration of VC measured by the Secretary of Labor was 1.7 ppm, or approximately one-thirtieth of the 50 ppm limit established by the standard. Nevertheless, the secretary argued that because some amount of VC, however small, is "released," Western Electric violated the standard by failing to monitor the coil coating operation. On the other hand, the employer contended that the standard was not intended to require monitoring when only a negligible amount of VC is released in an operation utilizing PVC.

Noting that Western Electric's decision not to monitor the coil coating process was based on foresight, the commission majority declined to find a violation of the standard. The result of the company's monitoring of the welding operation, coupled with its understanding of the process by which VC is released from PVC, strongly suggested that the amount of VC released in the coil coating operation would be negligible compared with 50 ppm, according to the majority. "Nothing in the record casts doubt on the validity of this judgment, or on the good faith with which it was made," the majority added in an opinion written by Chairman Frank R. Barnako. Commissioner Robert D. Moran concurred.

In the dissenting opinion of commission member Timothy Cleary, the standard requires monitoring of employee exposure levels in every operation in which any vinyl chloride is released. In his opinion, the majority has substituted its own monitoring standard. Since some quantity of VC was released into the work environment during the coating

operation and the operation was not monitored by Western Electric, Cleary would affirm the citation.

This ruling will appear in a future Decisions supplement.

Appropriations

REVIEW COMMISSION JUSTIFIES '78 REQUEST IN BUDGET FOR \$720,000 OVER '77 BASE

The Occupational Safety and Health Review Commission February 3 justified a \$720,000 increase in its budget request for fiscal 1978 amounting to a total of \$7,150,000, to the House Appropriations Labor-Health, Education, and Welfare Subcommittee.

The increase includes \$316,000 for employment of five additional administrative law judges, four clerical support positions for the ALJ's, one appellate counsel, and one secretarial position. The increases also include a \$150,000 supplemental request to support the FY 1977 pay raise.

In addition, other increases include \$108,000 to cover costs of converting from a commercial contractor for automatic data processing services to a commission-operated mini-computer system.

Review Commission Chairman Frank R. Barnako was requested by Congressman Silvio O. Conte (R-Mass) to answer for the record the following questions:

- ▶ How many cases has your commission successfully handled in the past year?
- ▶ Do you see a possible trend evolving toward an increase in this number as a result of the adoption of Rule 91a?
- ▶ Did you see any need to revise your budget requests since the adoption of Rule 91a?
- ▶ At what rate is your work load increasing every year?
- ▶ With the closing of field offices on the west coast how much will your case load decrease? What are the monetary savings?
- ▶ Will the combination of your extensive reorganization and congressional acceptance of your budget allow you to handle your case load efficiently?
- ▶ Where will these proposed new Administrative Law Judges be located?
- ▶ What is the price tag attached to your computerized retrieval and case tracking system?
- ▶ What are the unnecessary services you referred to which are provided by the G.S.A. and how much do they cost the commission?
- ▶ Do you know what the savings would be if you moved out of Washington D.C. and into the metropolitan area?
- ▶ What are the estimated savings in time and money related to the recent adoption of Rule 91a?

ASI 00022795

Utah

OSH ACT IS UNCONSTITUTIONAL, STATE DISTRICT COURT JUDGE RULES

The Utah Occupational Safety and Health Act violates the state constitution in several respects, a state court judge held on January 19.

Judge Bryant H. Croft of the District Court of the Third Judicial District, Salt Lake County, issued this ruling in a class action titled *Baird v. State of Utah* (Civil No. 237878).

Plaintiff R. Lamar Baird, a local businessman, filed suit on behalf of himself and all other Utah residents similarly situated, seeking an injunction against the enforcement of the state job safety law, which is modeled after the federal

Occasional Survey

GENETIC RISKS OF VINYL CHLORIDE

PETER F. INFANTE JOSEPH K. WAGONER
ANTHONY J. MCMICHAEL RICHARD J. WAXWEILLER
HENRY FALK

Division of Surveillance, Hazard Evaluations and Field Studies, National Institute for Occupational Safety and Health, and Bureau of Epidemiology, Center for Disease Control; and School of Public Health, University of North Carolina

Summary A study of pregnancy outcome among wives of workers exposed to vinyl-chloride monomer (v.c.m.) indicated that, in comparison with controls, there was a significant excess fetal loss in the group whose husbands had a primary exposure to v.c.m., whereas no differences between the groups were observed before the husbands' exposures. The difference in fetal death-rates for the post-exposure comparisons was a reflection of a greater fetal loss associated with the wives younger-aged husbands. The significant excess did not seem to be the result of bias from interviewers, respondents, nor from women who had experienced chronic abortions weighting the results. These findings, in conjunction with the demonstration of a mutagenic response via microbial test systems and with observations of significant excesses of chromosomal aberrations among workers exposed to v.c.m., raise scientific and public-health concern for the possible genetic risks of v.c.m. to man.

In the past year, several reports have indicated that vinyl-chloride monomer (v.c.m.) is mutagenic in microbial test systems.¹⁻³ v.c.m. metabolites also have induced mutations in mammalian cells.⁴ Likewise, reports from four countries have shown an excess of chromosomal aberrations in lymphocytes of workers exposed to v.c.m. compared with controls.⁵⁻⁸ However, Purchase et al.⁷ have stated (though no animal data were presented), that the mutagenic effects of v.c.m. expressed as chromosomal aberrations in lymphocytes in humans do not occur in germ cells in mice; they concluded that the potential danger of mutagenic effects on the fetus via sperm seemed unlikely to exist. In a study without controls, Selikoff observed fetal death-rates among wives of v.c.m. workers that ranged from 7 to 14 per 100 pregnancies.⁹ These rates appear to have been higher than expected.¹⁰

To develop further data on this question, pregnancy outcome has been studied among the wives of workers exposed to v.c.m. All current v.c.m. polymerisation and polyvinyl-chloride (p.v.c.) fabrication workers were included for study together with a similar number of current rubber workers (8% of all such workers) selected from work areas relatively free from known toxic materials and matched as a group to the v.c.m. workers by age. Group-participation rates ranged from 62 to 77%. Data for the wives of v.c.m. polymerisation workers (primary v.c.m. group) were contrasted with data for the wives of p.v.c. fabrication and rubber workers ("controls"), who were known to have had very low or no v.c.m. exposure, respectively. A total of 95

v.c.m. polymerisation and 158 rubber and p.v.c. fabrication workers were interviewed. Paternal age, pregnancy outcome, and estimates for the time of conception of all pregnancies were ascertained by interview in October, 1974, from males employed at a rubber manufacturing, p.v.c. fabricating, and v.c.m. polymerising facility. As part of a larger survey of worker health, date of first employment in the job categories was determined from company records. Mean paternal age, total number of conceptions, total number of fetal deaths (defined as any product of conception not born alive), and fetal deaths per 100 conceptions were then computed for each group prior to and subsequent to the worker's date of employment. No interviews were conducted with workers' wives and no data were obtained concerning maternal age, except indirectly through paternal age.

Since fetal loss is known to increase with ascending paternal age, the fetal death-rates for the primary v.c.m. exposure group were age-adjusted to the control group. Table 1 shows the age-adjusted fetal death-rates for wives of the primary v.c.m. exposure group versus the control group, both prior to and subsequent to each group's respective exposures. Among pregnancies occurring prior to exposure, fetal death-rates were 6.9% for the controls versus 6.1% (age-adjusted) for the primary v.c.m. exposure group. These rates were not significantly different by Mantel-Haenszel Chi-square testing.¹² Among pregnancies occurring subsequent to the husband's exposure, the difference in frequency of fetal deaths between groups was significant at $p < 0.05$ ($\chi^2 = 4.00$, $df = 1$).¹² Although the underlying distributions differed, mean paternal ages were virtually the same—30.4 versus 30.2 years. The significant difference between the groups subsequent to exposure was a reflection of a relatively greater fetal mortality-rate associated with younger-aged husbands in the primary v.c.m. exposure group. Among pregnancies occurring subsequent to exposure, the fetal mortality-rates associated with husbands 30 years of age and older for the primary v.c.m. exposure and control groups were 9/69 (13.0%) and 17/142 (12.0%), respectively; whereas, for

TABLE 1—MEAN PATERNAL AGE, NUMBER OF PREGNANCIES, AND FETAL DEATH-RATES ACCORDING TO HUSBAND'S V.C. EXPOSURE

	"Controls"	Primary v.c.m. exposure
<i>Prior to husband's exposure:</i>		
Number of families	95	70
Mean paternal age at conception (yr.)	23.0	26.4
Number of fetal deaths among wives	11	15
Number of pregnancies	159	148
Age-adjusted fetal deaths/100 preg.†	6.9	6.1
<i>Subsequent to husband's exposure:</i>		
Number of families	113	62
Mean paternal age at conception (yr.)	30.4	30.2
Number of fetal deaths among wives	24	23
Number of pregnancies	273	139
Age-adjusted fetal deaths/100 preg.‡	8.8	15.8§

*Rubber and p.v.c. fabrication workers.

†v.c. polymerisation workers.

‡Rates age-adjusted to "control" group paternal age distribution.

§Subsequent to husband's exposure, the frequency of fetal deaths among wives was significantly greater in the primary v.c.m. exposure group than in the "controls" ($p < 0.05$) or in the study group prior to husband's exposure ($p < 0.02$) by age-adjusted chi-square testing.¹²

TABLE II—MEAN PATERNAL AGE, NUMBER OF PREGNANCIES, AND FETAL DEATH-RATES ACCORDING TO HUSBAND'S V.C.M. EXPOSURE EXCLUDING PREGNANCIES OF WOMEN WITH ≥ 3 FETAL DEATHS

	"Controls"*	Primary v.c.m. exposure†
<i>Prior to husband's exposure:</i>		
Mean paternal age at conception (yr.)	23.0	26.3
Number of fetal deaths among wives	11	9
Number of pregnancies	159	141
Age-adjusted fetal deaths/100 preg.‡	6.9	3.1
<i>Subsequent to husband's exposure:</i>		
Mean paternal age at conception (yr.)	30.2	30.8
Number of fetal deaths among wives	18	14
Number of pregnancies	265	120
Age-adjusted fetal deaths/100 preg.‡	6.8	10.8

*Rubber and p.v.c. fabrication workers.

†v.c.m. polymerisation workers.

‡Rate age-adjusted to "control" paternal age distribution.

husbands less than 30 years of age, fetal mortality was 14/70 (20.0%) for the primary v.c.m. exposure group compared with 7/131 (5.3%) for the control group (these data are not shown in tables.)

Furthermore, intragroup comparisons indicated an increase in age-adjusted rates for the primary v.c.m. exposure group from 6.1% before exposure to 15.8% subsequent to the husband's exposure. This difference also was significant, $P < 0.02$ ($\chi^2 = 5.51$, $df = 1$).¹² Similar comparison for rates in the control group, 6.9% versus 8.8%, indicated no significant difference.

To determine whether women who had chronically experienced abortions might have weighted the results in favour of a higher fetal death-rate in the primary v.c.m. group subsequent to husband's exposure, pregnancies of women who had more than two abortions were eliminated from the analyses and the data were recalculated to determine whether or not the trend was maintained. The decision to exclude all pregnancies among families associated with more than two abortions was made without prior knowledge of how these families were distributed among the exposure categories. The data in table II show that the trend was maintained. Prior to exposure, the fetal death-rates in the control and primary v.c.m. exposure groups were 6.9% and 3.1% (age-adjusted), respectively, whereas, after exposure, the rates were 6.8% and 10.8%, respectively. Subsequently, data were eliminated for pregnancies of women who had experienced, firstly, more than one abortion, and, secondly, more than three abortions, and each time the trend was maintained. No changes in rates for controls were observed, whereas a 2–3-fold increase was observed in the primary v.c.m. group subsequent to exposure.

To determine whether differences in fetal loss might have been the result of one or two interviewers weighting the results, the data were analysed by individual interviewer. The results demonstrated a general trend for each interviewer to report a higher ascertainment among v.c.m. polymerisation workers than among the control group.

Further, the possibility was entertained that the interval between the date of interview and the date of fetal loss might have influenced the results through dif-

ferences in recall. The interval, however, was estimated to have been about two years less for controls, suggesting that, if a bias did exist, it would have been towards a greater ascertainment in the control group. In some cases, the worker failed to indicate the ages of his children and in other cases he was unable to recall the approximate time of his wife's abortion; therefore, the data were analysed to determine the distribution of fetal death-rates among the respondents in each occupational group who did not complete the interview properly. The difference in fetal death-rates between groups was very slight.

Finally, the workers may have been subject to bias resulting from prior knowledge of known hazards of vinyl chloride. However, the workers themselves did not always know into which of our employment categories they were being allocated. For example, several p.v.c. fabrication workers who were included in the control group thought that they had a primary v.c.m. exposure as a fabrication worker. In addition, the questions regarding pregnancy outcome were contained in a much larger interview-questionnaire, the results of which demonstrated very few significant differences with no consistent bias for the parameters ascertained between the workers with a primary v.c.m. exposure, and the other groups. This observation as well as several others presented above tend to support the validity of the study.

In summary, a significant excess of fetal loss was observed among wives of workers following exposure to v.c.m. The excess did not appear to be the result of bias from interviewers or respondents, nor from women who experienced chronic abortions weighting the results. Several mechanisms by which such fetal loss may arise are suggested. Either fetal or maternal toxicity or germ-cell mutagenesis in the mother through indirect v.c.m. exposure from the father might be considered, although these mechanisms seem highly unlikely in view of the highly volatile nature of v.c.m.¹³ When the findings of the present study are taken in conjunction with the prior demonstration of a mutagenic response via microbial test systems and observations of significant excesses of chromosomal aberrations among workers exposed to v.c.m., the leading possibility is germ-cell damage in the father through direct v.c.m. exposure. The increased fetal mortality among wives of workers subsequent to v.c.m. exposure now raises serious scientific and public-health concern for the possible genetic risks of vinyl chloride to man.

Requests for reprints should be addressed to P.F.I., N.I.O.S.H., Post Office Building, Room 515, Cincinnati, Ohio 45202, U.S.A.

REFERENCES

1. Bartsch, H., Malavielle, C., Montesano, R. *Int. J. Cancer*, 1975, 15, 429.
2. Lippincott, N., Barale, R., Varoncelli, S., et al. *Mutation Res.* (in the press).
3. Rannug, U., Johansson, A., Ramel, C., Wachmeister, C. A. *Ambio*, 1974, 3, 194.
4. Huberman, E., Bartsch, H., Sachs, L. *Int. J. Cancer*, 1975, 16, 635.
5. Ducatman, A., Hirschhorn, K., Selikoff, I. J. *Mutation Res.* 1975, 31, 163.
6. Funes-Cravioto, F., Lambert, B., Lindsten, J., Ehrenberg, L., Natarsajan, A. T., Osterman-Golkar, S. *Lancet*, 1975, i, 459.
7. Purchase, I. F. H., Richardson, C. R., Anderson, D. *ibid.* 1975, ii, 410.
8. Hillestad, L., Thies-Evensen, E. Unpublished.
9. Selikoff, I. J., N.I.E.H.S. Conference on Public Health Implications of Components of Plastics Manufacture, Pinchurst, North Carolina, July, 1974.
10. Infante, P. F. *Ann. N.Y. Acad. Sci.* (in the press).
11. Shapiro, S., Jones, E. W., Densen, P. M. *Milbank Q.* 1962, 40, 7.
12. Mantel, N., Haenszel, W. *J. Natn. Cancer Inst.* 1959, 22, 719.
13. United States Environmental Protection Agency, sampling and analysis of select toxic substances, task III vinyl chloride. Contract no. 68-01-2646. Jan. 20, 1976.