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Northern California: Warm today and turning dry. Turning cooler in interior areas late this week, especially overnight. Weather map and forecasts for other areas appear on page C4.

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MISCARRIAGES TIED TO CHIP FACTORIES

I.B.M. Finds a Chemical Risk for Some Women Workers

By JOHN MARKOFF

I.B.M. has warned its workers and other companies that two chemicals widely used in manufacturing semiconductor chips — and in other industries — may significantly increase the risk of miscarriage.

The computer maker acted after a study it commissioned by health researchers at Johns Hopkins University in Baltimore found that among 30 women who worked with the chemicals at two I.B.M. plants and then became pregnant, 10 had miscarriages — a 33.3 percent rate.

Despite the small number of pregnancies affected, the researchers believe there is a significant relationship between contact with the chemicals and women worker's miscarriages.

Used as Solvents

The two chemicals, diethylene glycol dimethyl ether and ethylene glycol monethyl ether acetate, are used as solvents in a portion of the chip-making processing that involves etching away some of the material deposited on a silicon wafer.

"The warning is a reflection of our increased understanding of the hazards of these chemicals," said James Cone, an expert in toxic chemicals and an assistant clinical professor at the University of California in San Francisco. "People have touted these as a safe alternative to chlorofluorocarbons and other chemicals, but we're finding out that there may be problems here as well."

Based on the study's findings, a num-

Miscarriages and Chip-Making Chemicals Linked

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ber of other technology companies have issued similar warnings in recent weeks. The chemicals are also used in other industries, like aerospace and printing, where thousands of workers may have come in contact with them.

None of the companies have stopped using the chemicals, but several chip makers have decided to offer alternative jobs to workers concerned about exposure.

"This is a confirmation of what has been known for some time," said Amanda Hawes, director of the Santa Clara Center for Occupational Safety and Health, a community research organization in California's Silicon Valley. "They're acknowledging something that people have had very serious concerns about and have been trying to do something about."

The International Business Machines Corporation commissioned the Johns Hopkins study in 1987 in an attempt to prove that its semiconductor manufacturing operations were safe. It acted after an earlier study by the University of Massachusetts for the Digital Equipment Corporation developed evidence of significant health risks in chip-making operations, an I.B.M. spokesman said.

The spokesman, Jim Ruderman, said the company did not believe there was reason for alarm. "We want to be careful," he said. "We're not trying to be alarmists. There hasn't been a mass panic nor should there be."

A possible blow for an industry seen as safe to the environment.

I.B.M. issued the warnings last month after it received preliminary data from the study, which is not scheduled to be completed until next year. Because of the nature of the findings, the company also reported them to the Environmental Protection Agency. Although it made no public announcement, I.B.M. acknowledged its actions over the weekend.

A Look at 2 Plants

The study, which looked specifically at potential problems for women, tracked workers at I.B.M. plants in Burlington, Vt., and East Fishkill, N.Y., from 1980 to 1989. It found that the miscarriage rate for workers who worked at the plants but did not come in contact with either of the chip-making chemicals was significantly lower than for women who did. The study showed 62 miscarriages out of 398 pregnancies, or 15.6 percent, among women who did not handle the chemicals, in contrast to the 33.3 percent rate for the women who did.

"The primary motivation for the study was to try to clear the tarnished reputation of semiconductor clean-

room health risks for women after the Digital study," Mr. Ruderman of I.B.M. said. "If there are any bright spots here, it's that the rest of the operations in our clean rooms are safe." Semiconductor chips are made in special rooms virtually free of dust and other contaminants that might spoil the manufacturing process.

The new concerns about worker health and safety may prove a potential black eye for a high-technology industry that has long sought to portray itself as clean and with little impact on the environment.

I.B.M. gave information from the study to companies that are members of the Semiconductor Industry Association, Intel, Texas Instruments, A.T.&T., Advanced Micro Devices, Signetics and National Semiconductor have all notified their workers of a potential health risk from exposure to the chemicals in recent weeks, said Thomas Beer-mann, an association spokesman.

"The findings are of great interest, but because of their preliminary nature and the need to know more, there aren't a lot of alarm bells going off in the industry," he said.

Changes in Production

Several industry executives also said that the Johns Hopkins study was a retrospective one and that many of the production processes have since changed, offering workers more protection from chemicals. Moreover, in some cases new chemicals have replaced ones that have been found to cause health risks.

Sematech, the consortium of chip

makers in Austin, Tex., began independently to look for alternatives to the chemicals mentioned in the Johns Hopkins study six months ago because of general concerns about hazardous chemicals. A spokesman for the consortium said yesterday that no alternatives had been found yet.

Although the industry is acting to warn its workers now, workplace health experts said semiconductor makers have been slow in responding to growing evidence that there are demonstrated reproductive and other health effects related to chemicals.

Other Chemical Studies

Ms. Hawes of the Santa Clara Center for Occupational Safety and Health said there were also a variety of concerns about the class of chemicals known as glycol ethers used in consumer products like paints, cleaning agents and antifreeze. Although the effects of these chemicals are not yet clear, she said there were animal studies done as far back as 20 years ago indicating they may pose risks other than to reproductive health.

Health researchers have for some time raised questions about health and safety issues in the semiconductor industry because of the fast pace of technological change. While many chemicals that have been found to be dangerous have been replaced by new manufacturing processes, new manufacturing technologies are introduced so rapidly that it is not always possible to immediately assess their long-term health impact.

Mr. Ruderman of I.B.M. said the company was taking the precaution of notifying its work force despite the fact that there were several weaknesses in the Johns Hopkins study. For example, he said, the study did not measure exactly what level of exposure to the chemicals individual workers experienced or to eliminate the possibility that the miscarriages in the study were caused by other chemicals.

Second Study

The industry association is currently paying for a second \$3.5 million study of the health of workers in the semiconductor industry. That study is being conducted by researchers at the University of California at Davis and is scheduled to be completed before the end of this year.

I.B.M. officials said that there were about 1,200 workers at its two major United States chip-making plants, of which 300 are women. The company said it had held meetings with tens of thousands of its workers during the middle of last month, offering technical information and job transfers.

After the briefings, about a dozen women sought further information from I.B.M. medical representatives, the company said.