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UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

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**INFORMATION REPORT**

For: The Commissioners

From: Robert B. Minogue, Director  
Office of Standards Development

Thru: Executive Director for Operations *[Signature]*

Subject: REPORTED EXCESS NUMBER OF BIRTHS WITH THYROID ABNORMALITIES  
NEAR TMI

Purpose: To inform the Commission of issues pertinent to the reported  
excess and the likelihood of an association with the TMI  
accident.

Discussion: On February 21, 1980, a Washington Post article (Enclosure 1)  
stated that an abnormal number of children were born with serious  
thyroid defects in three of the counties near TMI in the latter  
part of 1979. A detailed discussion of relevant information  
regarding diagnoses, dosimetry and expected health effects is  
presented in Enclosure 2. There appears to be no connection  
between the thyroid defects and TMI radiation releases.

*Robert B. Minogue* 2/28/80  
Robert B. Minogue, Director  
Office of Standards Development

Enclosures: 1 & 2  
Detailed Discussion

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# A-Plant Involved in Probe of Thyroid Ills

By Victor Chan

Washington Post Staff Writer

A new controversy over the nuclear accident at Three Mile Island appears likely to arise from the discovery that an abnormal number of children were born with serious thyroid defects in Pennsylvania counties in the latter part of this year.

The condition is known as hypothyroidism, a disease where the thyroid gland in the neck does not produce enough normal hormone levels. It can lead to grave mental retardation and stunted growth unless it is quickly treated.

State health officials confirmed yesterday that during the last nine months of 1979, 13 hypothyroid babies were born in three counties that might ordinarily expect three such births during that length of time. They said they are about to start an epidemiological investigation that "will require a lot of data," said Dr. Thomas Foley of Pittsburgh Children's Hospital, an authority on hypothyroidism—all said that the conditions could have many possible causes.

They said they know of no cases of hypothyroidism ever caused by radiation at the low level emitted by a crippled reactor, though there is a well-established association between high doses of radioactive iodine—one chemical emitted by the damaged reactor—hypothyroidism in the thyroid gland, with destructive effects when the dose is high enough.

Radiation specialists from the President's Commission on Three Mile Island and the Nuclear Regulatory Commission said flatly yesterday that iodine emissions from the March accident were far too low to have had any such effect.

"There cannot be any connection; I can say that unequivocally," said Dr. Victor P. Bond, associate director of the Brookhaven National Laboratories for biomedical and environmental research, a major center for the thyroid gland, said that the prevalence of health effects "for thyroid effects the dose would have to have been thousands of times higher than they were."

Hiroshi Peterson of the NRC's office of standards said a total of 18 cases

of iodine 131 was released from the plant by the end of April, giving a maximum radiation dose of the thyroid of area residents of 8 to 20 millirems.

Background radiation provides 100 millirems per year. Tests of area residents revealed no iodine in their blood, and none was detected in area animals or in cow's milk. Blood said. To officials, it seems there since the accident would have required a pickup of iodine.

"We would certainly not expect any effect on fetal thyroid from these levels," Peterson said.

A spokesman for General Public Utilities Inc., parent company of the utility that owns Three Mile Island, said no iodine measurements taken were ever high enough to cause fetal thyroid problems.

However, several local groups have challenged the official radiation monitors, alleging that insufficient monitors were in place or operating at the time of the accident. Wind currents might have carried radioactive particles over nearby monitors and deposited them in faraway areas without the normal dispersal effect, these groups have said.

None of the hypothyroid cases were in areas that have been described as the main "plume" or downwind direction of the Three Mile Island radiation.

Six cases occurred in Lancaster County, which is part of Dauphin County, the reactor site. Four were in Berks County and three in Lehigh County.

Ordinarily one baby in 3,000 is born with hypothyroidism. In 1978 (the last year for which full birth statistics were available yesterday) Lancaster County had 2,500 live births, Berks County, 4,400, and Lehigh, 3,200.

Unusual clusters, mere statistical aberrations, sometimes occur in many diseases, said Dr. Arnold Muller, secretary of health in Harrisburg.

Also, said both Dr. Foley and Dr. Evelyn Rodin, a Pennsylvania health department pediatrician, a more logical explanation than radiation has been found in three and possibly four of the Lancaster County cases, the group most closely studied so far.

One had a familial or inherited condition and two had a misplaced thy-

roid gland, a condition not likely to be caused by radiation, Rodin said. The three other Lancaster County cases are still under study, but one was a twin whose twin did not get the disease "so it's unlikely" though not impossible, she said, that the reason in both cases was something other than the same environment.

Another health authority said that many populations, such as the Amish, in Pennsylvania have a high concentration of genetically related diseases.

"I don't think there's any cause and effect" connected to Three Mile Island, Rodin said. Dr. Foley agreed, but called the timing "bizarre and curious," and said "the fact that it did follow the accident raises an issue" that must be settled.

The cases' existence was disclosed in an interview yesterday by Dr. Gordon MacLeod, who was Pennsylvania health secretary at the time of the accident, and became the state's chief health officer on March 15, only 12 days before the accident. Last Oct. 16, he said—after criticizing the state's handling of the problem—that he was asked by Gov. Richard Thornburgh to

retire. He returned to his job as a well-regarded professor of public health administration at the University of Pittsburgh.

MacLeod, 55, agreed that "it is impossible" to assess any common cause for the thyroid defects. But he said he was shocked that the health department had made no study or investigation of possible causes. The first of the affected Lancaster County babies was born last June. Two were born in July, and one each in August, October and November.

MacLeod also said it is "urgent" to look for any possibly undetected cases in babies born at home among the Amish and other Pennsylvania who often choose home deliveries.

Thyroid problems turned up among Marshall Islanders who were exposed to radiation from the fallout of a U.S. hydrogen bomb test in the Pacific on March 1, 1966.

The first cases discovered since the accident were children under 5 at the time of exposure, whose thyroid glands had disappeared.

Staff writers Walter Pines and Joseph O'Quinn contributed to this report.

Early Edition



# Infant Thyroid Ills Stirring Three Mile Island Inquiry

By Victor Cohen  
Washington Post Staff Writer

A new controversy over the nuclear safety of Three Mile Island has been stirred by the discovery that an abnormal number of children were born with serious thyroid defects in Bucks County, Pa., in the last year.

The condition is known as hypothyroidism, which arises when the thyroid gland is either absent or doesn't produce normal hormone levels. It can lead to grave mental retardation and stunted growth, unless it is quickly treated.

State health officials confirmed yesterday that during the last nine months of 1967, hypothyroidism had been diagnosed in three children in Bucks County, Pa., and one in Lancaster County, Pa.

They said they know of no cases of hypothyroidism ever caused by radiation at the low level emitted by a crippled reactor, though there is a well-established association between high doses of radioactive iodine—some chemical emitted by the disabled reactor—and thyroid disease. Radioactive iodine tends to concentrate in the thyroid gland, with destructive effects when the dose is high enough.

Radiation specialists from the President's Commission on Three Mile Island said the children were not exposed to radiation from the reactor. They said the children were born in the last year of last year.

There is no known association between the children and the reactor, which was closed in 1967 after a series of accidents. It is not known whether the children were born with the condition or whether it developed later.

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State health officials confirmed yesterday that during the last nine months of 1967, hypothyroidism had been diagnosed in three children in Bucks County, Pa., and one in Lancaster County, Pa.

maximum radiation dose in the thyroid of area residents of 1 to 20 millirem.

Background radiation provides 100 millirem per year. Tests of area residents revealed no iodine in their bodies, and none was detected in area animals or in cow's milk, Bond said. To affect fetuses born since the accident would have required a pickup of iodine.

"We would certainly not expect any effect on fetal thyroids from these levels," Peterson said. "General Public Utility has been very cooperative in utilizing the area's Three Mile Island, said no iodine measurements taken were ever high enough to cause fetal thyroid problems."

However, several local groups have challenged the official radiation readings, alleging that insufficient monitors were in place or operating at the time of the accident. Wind currents might have carried radioactive particles over nearby monitors and deposited them in farmyard areas without the normal dispersal effect, these groups have said.

Dr. Harold Peterson of the NRC's office in Washington said a study of 15 cases of iodine 131 was ordered from the area that had been described as the main "plume" of downwind fallout.

Six cases occurred in Lancaster County, which is east of Dauphin County, the reactor site. Four were in Bucks County and three in Lehigh County.

Ordinarily one baby in 1,000 is born with hypothyroidism. In 1978 the last year for which full birth statistics were available yesterday, Lancaster County had 3,500 live births, Bucks County, 4,483, and Lehigh, 3,208.

Unusual clusters, more statistical aberrations, sometimes occur in many diseases, said Dr. Arnold Miller, secretary of health in Lancaster County. "We don't know why these cases occurred," he said.

Dr. Miller said Dr. Peterson and Dr. Bond, both Pennsylvania health department pediatricians, a more logical explanation than radiation has been found in three and possibly four of the Lancaster County cases, the group most closely studied so far. One had a familial or inherited condition and two had a misplaced thyroid gland, a condition and likely to be caused by radiation, Bond said. The three other Lancaster County cases were in Lehigh County, but not in the same "plume" area.

this case was environmental, since both babies were subjected to the same environment.

Another health authority said that many populations, such as the Amish, in Pennsylvania have a high concentration of genetically related disorders. "I don't think there's any cause and effect relationship," he said.

Bond said Dr. Foley agreed but called the timing "curious" and said "the fact that it did follow the accident raises an issue that must be settled."

The case's existence was disclosed in an interview yesterday by Dr. Gordon MacLeod, who was Pennsylvania health secretary at the time of the accident. He said the state's chief health officer on March 15, only 12 days before the accident, last Oct. 10, he said—after criticizing the state's handling of the problem—that he was asked by Gov. Richard Thornburgh to resign. He returned to his job as a well-regarded professor of public health administration at the University of Pittsburgh.

MacLeod, too, agreed that "it is impossible" to assign any common cause to the thyroid defects. But he said he was troubled that the health department had made no public statement.

movement and had not started an investigation of possible causes. The first of the affected Lancaster County babies was born last June. Two were born in July, and one each in August, October and November.

MacLeod also said it is "urgent" to look for any possibly undetected cases in babies born at home among the Amish and other Pennsylvania residents who choose home deliveries.

Thyroid problems turned up among Marshall Islander who was exposed to radiation from the fallout of a U.S. hydrogen bomb jet in the Pacific on March 1, 1964.

The first case discovered nine years later were two children, under 10 at the time of exposure, whose thyroid glands had disappeared. "Altogether, of 5 children under 12, who lived on Rongerik Island, some 110 miles from the first site, 18 developed thyroid problems or tumors before they were after exposure. "The 10 years after exposure, "MacLeod said, "it is impossible to measure the thyroid gland. The only way to measure it is by the Amish. The first case in 1964, was reported at 178 RER. Staff writers Walter Pines and John O'Quinn contributed to this report."

Late Edition

ENCLOSURE 2

Children born with thyroid defects were discovered through the normal operation of a neonatal metabolic screening program that has been operating since July 1978. These defects resulted in diagnoses of hypothyroidism. Although baseline incidence data on hypothyroidism are not available for Pennsylvania, the number of cases detected statewide in 1979 is no more than expected, based on previous studies in the United States and Canada, according to Dr. Evelyn Bodin of the Pennsylvania Department of Health, who heads up the screening program.

The purpose of the neonatal screening program is to find newborns with metabolic defects such as phenylketonurea and hypothyroidism early enough after birth to prevent severe mental retardation. Several states, including New York, New Jersey and Maryland have similar programs. Hypothyroidism is detected in the program by looking for depressed levels of thyroid hormone and elevated levels of thyroid stimulating hormone in the infant's blood. Confirmation is done by thyroid scan. The thyroid scan can determine whether the hypothyroidism is due to the absence of a gland, difficulty with hormone synthesis or release, or displacement of the gland from its normal position. Sometimes, however, confirmatory studies are not done or not reported to the health department, resulting in the classification of the cause as "unknown on scan". According to Dr. Bodin, the fourteen cases of hypothyroidism are classified as follows:

Lancaster County (7 cases)

1 was a case of severe multiple brain abnormalities



Lancaster County (contd)

2 were cases of dysgenesis, i.e. the thyroids were displaced from their normal position

1 was a case of dyshormonalgenesis, i.e. it is familial and inherited as an autosomal recessive

3 were "unknown on scan" (One of these occurred in January 1979, before the accident)

Bucks County (4 cases)

3 were "unknown on scan"

1 was a case of dysgenesis, i.e. displaced from its normal position

Lehigh County (3 cases)

1 was "unknown on scan"

2 cases were twins who had no thyroids

Except for those cases that were "unknown on scan", these types of anomalies are not expected to result from direct or indirect exposure of the fetus to radioiodine. Dr. Bodin reported that "there is no reason why they should be related to radiation."

Lehigh and Bucks counties are not adjacent to Dauphin County (where TMI is) and Lancaster county is southeast of the site. The Post article reports that local groups contend that "insufficient monitors were in place or not operating at the time of the accident" and that "wind currents might have carried radioactive particles over nearby monitors and deposited them in faraway areas." This kind of reasoning would be necessary to explain the pattern of the reported excess incidence. However, it should be noted that estimates of the radioiodine releases are not subject to the same degree of uncertainty that is associated with the quantity of the noble gas activity

release. The amount of radioiodine released has been estimated from the amounts retained on the effluent particulate and charcoal filters. By analyzing the distribution of radioiodine with depth of the filter, it was possible to estimate the efficiency of the filters and the quantity released. Both the NRR staff and Special Investigation Group (Rogovin Report) estimated that approximately 15 curies of radioiodine -131 were released, the maximum quantity estimated by the Rogovin group was 32 curies. Analysis of effluent air sample cartridges by the licensee gave estimates of 14.1 curies of iodine -131 and 2.6 curies of iodine -133. All estimates are for the period March 28 - April 30, 1979. The total uncertainty is therefore within a factor of 2.

The maximum airborne iodine concentrations of 120-250 pCi/m<sup>3</sup>\* occurred mid-April in connection with replacement of the auxilliary building charcoal filters. The maximum predicted thyroid dose from inhalation was approximately 20 millirem\*\*to a child.\*\*\* Extensive milk monitoring was performed by EPA, FDA, NRC, the State, and the licensee. The maximum radioiodine concentration in cow's milk was 36 pCi/liter which would have resulted in a thyroid dose to an infant of less than 5 millirem. Higher radioiodine concentrations were observed in goat's milk (41 pCi/liter and 110 pCi/l). Even though this milk was not used for human consumption,

\*The 10 CFR Part 20 concentration limit for continuous annual exposure is 100 pCi/m<sup>3</sup>.

\*\*for the period March 28 - April 30, 1979.

\*\*\*NRC staff panel report to the Commission on Extraordinary Nuclear Occurrence (NUREG-0637), Appendix E, page 30.



the projected thyroid doses to infants would be 5 millirem and approximately 14 millirem, for the 41 and 110 pCi/liter concentrations. These values are under the 10 CFR Part 50, Appendix I design objective for normal operation of 15 millirem per year per reactor unit.

Although the uptake physiological parameters for the fetus are not well defined, a conservative upper bound estimate is that the thyroid dose to a fetus might be as high as 10 times the maternal adult dose. This would give a maximum thyroid dose to a fetus of 140 millirem from inhalation plus 50 millirem from milk ingestion or approximately 200 millirem total fetal thyroid dose.

Estimates of the health effects of thyroid irradiation are derived from studies of persons irradiated for ringworm, Marshallese Islanders exposed to fresh fallout, and atomic bomb victims. The risk estimate (based on children and teenagers) derived from the Marshallese data is 175 thyroid cancers per million-person-rem. These are from substantial doses, the average thyroid dose being 200 rem. The risk is believed to be higher in younger children. When adjusted for the U.S. population, an average risk of 50-70 thyroid cancers per  $10^6$  person-rem would be more appropriate. When applied to the doses at Three Mile Island (3300 person-rem total body + 1280 thyroid-rem), approximately 0.27 potential thyroid cancers would be predicted using the population average risk and 0.8 potential cancers using the higher Marshallese risk value for children. Thyroid cancer can be effectively treated and the fatality rate is less than 10 per cent.

Radioactive iodine is routinely used for therapy of hyperthyroidism (over-active thyroid) at doses of the order of 1000 rem or more and hypothyroidism is commonly observed as a result. Impaired thyroid function (hypothyroidism)

has been found to be prevalent in the exposed Marshallese at doses of about 50 rem (27-95 rem).

Based upon a conservative upper bound estimated total collective dose at TMI of 4580 person-rem (3300 total body, 1100 thyroid-rem from milk and 180 thyroid-rem from inhalation) the expected number of cases of hypothyroidism would be 0.6 (range 0.1-2.8) based upon our calculations using the Marshallese risk data.