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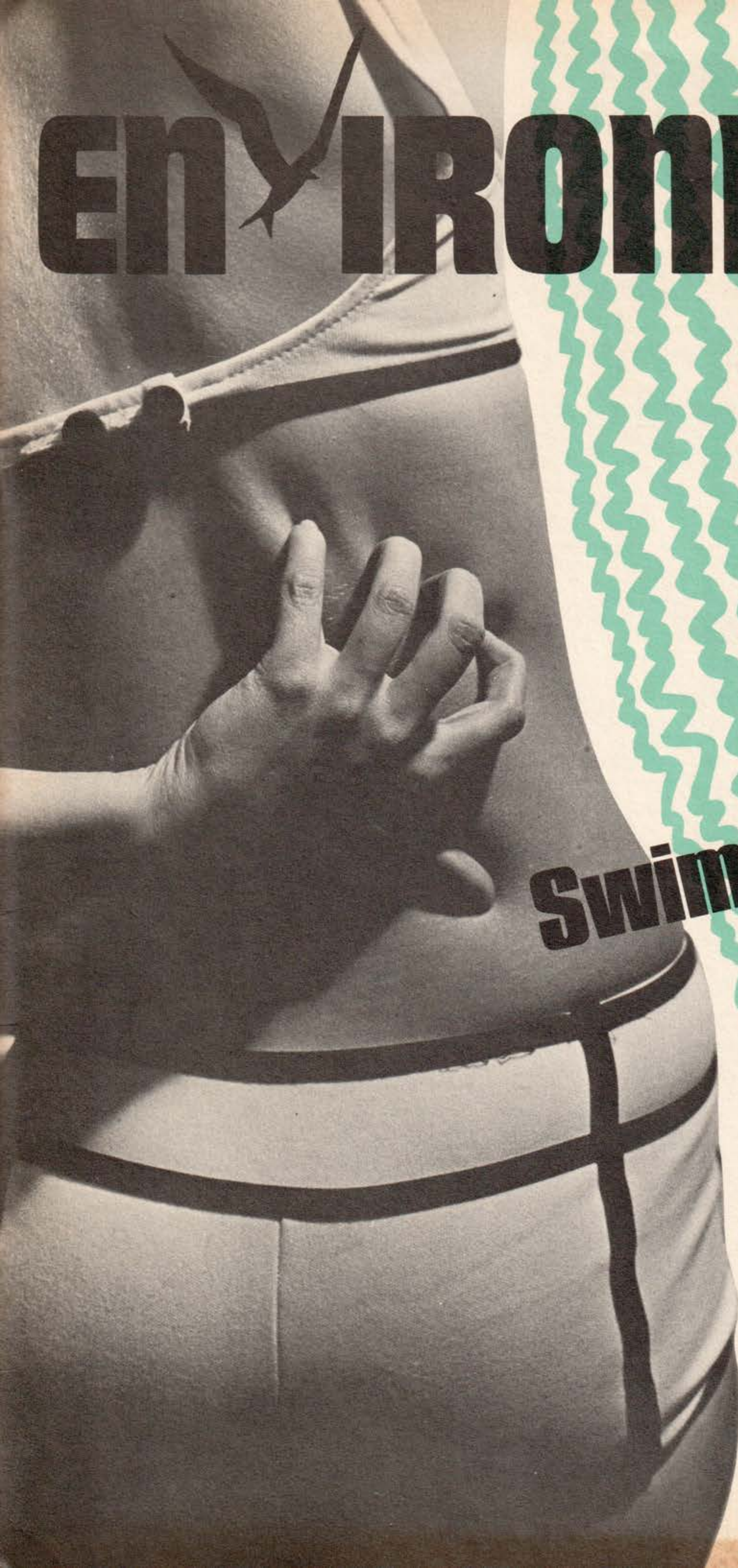

Swimmer's Itch

Environment — Don Reuter

By Michael W. Friedlander and Joseph Klarmann

How Many Children?

THE EFFECTS OF FALLOUT from nuclear weapons explosions have been of concern to the Committee for Environmental Information (CEI), publishers of *Environment,* since its founding. Over the years we have maintained this interest and have published articles covering a variety of aspects of this problem: the effects of radiation on men, animals, and plants; the production of radioactive isotopes; and the different paths by which these isotopes may be carried in our environment and into our foods. Recently we have received a large number of requests to comment on claims of Dr. Ernest Sternglass, of the University of Pittsburgh, that fallout from atmospheric tests of nuclear explosives is responsible for an apreciable fraction of the fetal and infant mortality in this country. It is clearly appropriate for *Environment* to review this subject and to bring our readers up to date. A presentation of Dr. Sternglass's position follows this article.

Dr. Sternglass is a physicist in the Department of Radiology and Division of Radiation Health of the University of Pittsburgh. His statements are based on an analysis of trends in infant mortality and fetal death rates across the United States, correlating these with levels of fallout radiation.

Figure 2 in the statement by Sternglass which follows this article is representative of the data he uses in support of his thesis. Sternglass draws attention first to the steady decrease in infant mortality rates in many countries for the period from the middle 30's to the early 50's. The graph shows clearly that the decline slows down markedly around 1950 when extensive bomb testing started, and seems to go back to its original rate only some years after the termination of atmospheric tests in 1963.

The conclusion that he draws is that the rate would have continued to decline without interruption along the line he draws were it not for the effects of fallout. Between this projected line and the actually recorded numbers, the difference must then, in Sternglass's view, represent deaths directly attributable to fallout. Sternglass has also interpreted some of the subsidiary peaks in mortality as being due to specific tests, for instance the first H-bomb explosion.

Sternglass also discusses the infant mortality rate on a state-by-state basis and seeks to relate these to *fallout from the first atom bomb explosion, the*

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Death rates for newborn infants are higher in the United States than in most industrialized countries, and are nearly twice as high as in Sweden. Poverty and malnutrition are the most frequently cited causes of the high infant mortality rate, but recently Ernest J. Sternglass has claimed to show that radioactive fallout from nuclear weapons tests is the source of one out of three infant deaths. (Shown *at left are normal, healthy infants in their first week of life.)*

Trinity test at Alamogordo, New Mexico in 1945. Figures 4 and 5 demonstrate this argument. He has computed for each state the trend of decline of the infant mortality rate for the period 1940 to 1945. On the basis of this decline he then predicts the expected rates for 1946 and 1950 and plots on the map the percentage by which each actual rate differed from the predicted one. The negative numbers indicate actual mortality levels below the predicted levels; positive numbers show mortality levels in excess of the expected rates. Sternglass has indicated by hatching those states where the excess in mortality rate was greater than five percent. He concludes that the excess is due to fallout from the single bomb test at Alamogordo, New Mexico and that New Mexico is spared due to its low rate of rainfall.

Sternglass has also claimed that the infant mortality in other "wet" states (those which have heavy annual rainfall) declined more slowly in later years following nuclear tests in Nevada than in neighboring "dry" states (those which experience light rainfall). In addition he has correlated the excess mortality rate with the total amount of strontium 90 produced, the strontium 90 level in milk (taking overlapping averages over four years), and the amounts of strontium 90 in deciduous teeth. Most of this data is summarized by Sternglass in the graphs given in his statement which follows this article.

From the data and correlations which he has discussed and the inferences which he draws, Sternglass recommends that:

> In view of the evidence of an association between nuclear testing and the increase of fetal and infant mortality in the United States, an association which appears to be of a direct causal nature, the need to end all further atmospheric weapons testing and to halt all shallow underground cratering tests that permit escape of radioactive material into the environment is of paramount urgency.
>
> Since significant changes in the rates of fetal and infant mortality seem to have been produced as the result of tests in 1945-54 involving only a handful of kiloton weapons now classified as "tactical" in size, the full dimensions of the threat to the biological survival of mankind posed by a possible nuclear war become apparent.

The balance of evidence, at this time, would appear not to support Sternglass's thesis, but effects at a considerably lower level may yet be detected.

He also argues that the use of ABMs is unthinkable, because the same hazards would be posed.

Sternglass has presented his findings at several symposia and has published several articles. There has been a special supplement to *Esquire* magazine. A film of a lecture in which he presents his findings has been shown on educational television, and he has been the subject of news articles in *Science* and *Scientific Research*. Following his initial publication in the *Bulletin of the Atomic Scientists*, there have been some correspondence, a rebuttal, and a reply from him in later issues. There has been similar coverage and rebuttal in the *New Scientist*.

His methods of analysis and his conclusions have been subjected to strong criticism by scientists acquainted with this field, but there is general agreement on the importance of the subject and the need for further study. It is fair to say that a relation between fallout and infant and fetal death rate *may* exist, but that Sternglass has not yet made an adequate case to prove it on the basis of the evidence we have reviewed. Of course, if such a causal relationship exists, then it has the most important implications. In order to demonstrate such a relationship, it is not necessary to find and to understand all the biological steps between the radiation and subsequent death. For example, we do not understand all the biological steps that lead from smoking to cancer; nevertheless, a causal relationship has been convincingly demonstrated in two ways: One, by the repeated showing that when groups of smokers and nonsmokers in other respects similar in age, background, occupation, etc., are compared, smokers have a higher rate of lung cancer; and two, by the production of lung cancers in laboratory animals by exposure to tobacco smoke.

There is a wealth of accepted data linking radiation with adverse biological results: leukemia among Nagasaki and Hiroshima survivors; cancer among uranium miners; and extensive research with a wide variety of animals which shows that genetic effects may appear at quite low doses. What is now being proposed by Sternglass, and disputed, is an additional effect of far greater magnitude than any yet observed, which requires some radiobiological link not yet identified or understood. Sternglass seeks to demonstrate the correlation by showing that at particular times and places where radioactive fallout was high, changes in the rate of infant and fetal death were observed which can be attributed to the fallout and not to nutritional deficiencies or other environmental factors.

The evidence which Sternglass presents to support his conclusion that there is such a previously unknown effect has been examined by other scientists. John H. Harley, Director of the Atomic Energy Commission's Health and Safety Laboratory, reviewed some of Sternglass's data in the Laboratory's quarterly report dated October 1, 1969.

According to Harley, there are three ways in which Sternglass has made use of fallout data, and in each case the data used are faulty. The most disturbing of Sternglass's arguments is summarized in Figures 4 and 5, showing a dramatic change in infant mortality in southeastern states as a result of the Trinity test in Alamogordo, New Mexico. According to Harley, from wind data of the period it is possible to estimate the path taken by fallout from that test, even though no fallout measurements beyond 150 miles were made at the time. On the basis of wind data, Harley reasons that most of the fallout was deposited in New Mexico, and the remaining clouds were carried to the northeast, over states which showed a much greater improvement in infant mortality rates than was expected.

Although we have not been able to find accurate wind data, Harley's version is supported by a popularized account of the first atomic test, *Day of Trinity*, which describes the observations of the B-29 pilot whose task was to track the fallout cloud created by the explosion:

> In another five minutes variable winds had torn the cloud into three distinct sections, which drifted off in different directions. The largest and topmost section, a dense white mushroom trailed by a dusty brown streamer, began riding the winds of the troposphere toward the northeast.

Ground-level measurement was limited to that done by teams from the test site. According to this account, there were measurements of fallout over 100 miles north of the test; this does not rule out the possibility that fallout was carried in other directions.

Fallout from this test, according to Harley, did not follow the arrows shown in Sternglass's drawings, and did not reach the states in which he claims it caused infant mortality higher than expected.

According to Sternglass, in the years following 1950, nuclear testing at Nevada and in the Pacific caused an overall increase in infant mortality (above what would otherwise have been expected) in those states which received higher rainfall and therefore, presumably, higher fallout. Harley points out that the assumption that fallout rates are related to rainfall rates is one which was made for purposes of prediction in the Federal Radiation Council's report which summarized data for 1963. This connection between rainfall rates and fallout rates is not generally valid, nor was the distribution of fallout during 1963 typical of other years. Harley, however, contends that the pattern of fallout during the first five years of testing was very different from that claimed by Sternglass, and that over all the years of testing the deposition of strontium 90 in each of the various states has turned out to be surprisingly regular, so that direct measurements disprove the "wet-" versus "dry-" state variation predicted by Sternglass.

Other factors than fallout, such as poverty, are clearly important causes of infant mortality.

Sternglass does not consider other possible interpretations of the data. If a mortality rate in a particular state were to decline exactly along the predicted line of a graph of the type shown in Figure 2, then there would be no excess and such a state would appear on Figures 4 and 5 as a zero. This should be the case for states not strongly affected by fallout. Positive numbers in Figures 4 and 5 indicate states where mortality rates were in excess of the predicted ones, and Sternglass's analysis is mainly concerned with these. But what of those states with minus signs to their numbers? Following the same pattern, these are states in which the decline of the mortality rate was *more* rapid than anticipated, and we note that while only a few states show this effect in his 1946 display, the effect has spread by 1950. We find no discussion by Sternglass of this phenomenon, which cannot simply be ignored if his method of analysis is to be taken seriously. Indeed, this alone seems to us a very strong indication that his predicted mortality rate is of low statistical validity. Presumably there are economic and social changes or other factors which account for the more rapid decline of infant mortality in some states, an effect which seems at least as large as the levelling-off in the states selected for attention by Sternglass. Even a cursory comparison of the maps shows that large changes in infant mortality rates, entirely unconnected with fallout levels, have occurred throughout the country. This being so, before any demonstration could be made that fallout has affected death rates in one part of the country, the other forces at work would have to be identified and their effects separately estimated. This Sternglass has failed to do.

Criticisms raised by others are equally far-reaching. Dr. Alice Stewart, an epidemiologist in the De-

Other factors than fallout, such as poverty, are clearly important causes of infant mortality.

Two maps in which Sternglass shows his argument that fallout from a single bomb test in New Mexico in 1945 caused higher infant mortality in the South. The original maps as presented by Sternglass are shown on pages 10 and 11, and are here redrawn in different form. The arrows represent the path Sternglass assumes fallout from the test followed. There is no direct evidence of the actual path taken. The white states are those in which infant death rates were more than five percent worse than the rate which would have been predicted by prior experience. Dark grey areas represent states in which infant mortality has improved more than five percent over the rate which would have been predicted. Harley and others claim that fallout from the 1945 test was carried to the northeast rather than east as Sternglass claims. If Sternglass's arrows were redrawn toward the northeast these maps could be used to argue the existence of an improvement in infant mortality in New England and the Great Lakes states due to fallout, instead of a worsening in the Southeast. Of course, no one makes any such claim. Other forces than fallout alone would seem to be at work.

partment of Social Medicine, Oxford University, writing in the *New Scientist* (24 July 1969), considers that.

> The most likely explanation of the observed change in trend is that it is a reversion towards a normality of a death rate which had, for twenty years, been experiencing booster effects — first from the introduction and dissemination of sulfonamides [sulfa drugs], and then from the introduction and dissemination of antibiotics.

She also comments that:

> In practice, infection deaths are so strongly correlated with sex, age, wealth, climate, density of population, chemotherapy, and so on, that any deviation from normality of related death rates and prevalence rates (for example infant mortality, leukemia mortality and leukemic clusters) can only be regarded as significant *after* these effects have been eliminated.

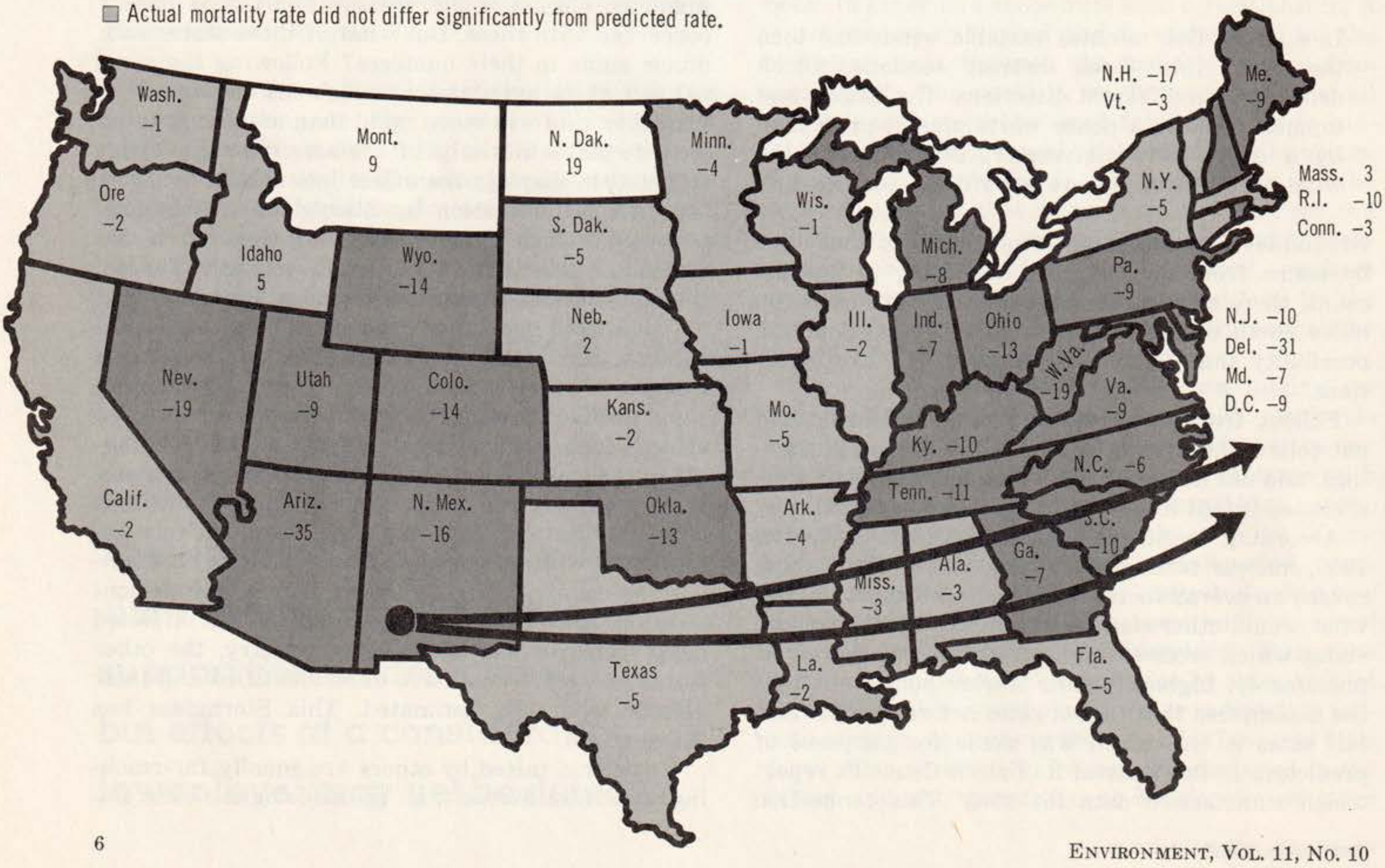
Dr. Leonard Sagan (Associate Director of the

■ Actual mortality rate was more than 5% less than the rate predicted by Sternglass

□ Actual mortality rate was more than 5% in excess of the rate predicted by Sternglass

▨ Actual mortality rate did not differ significantly from predicted rate.

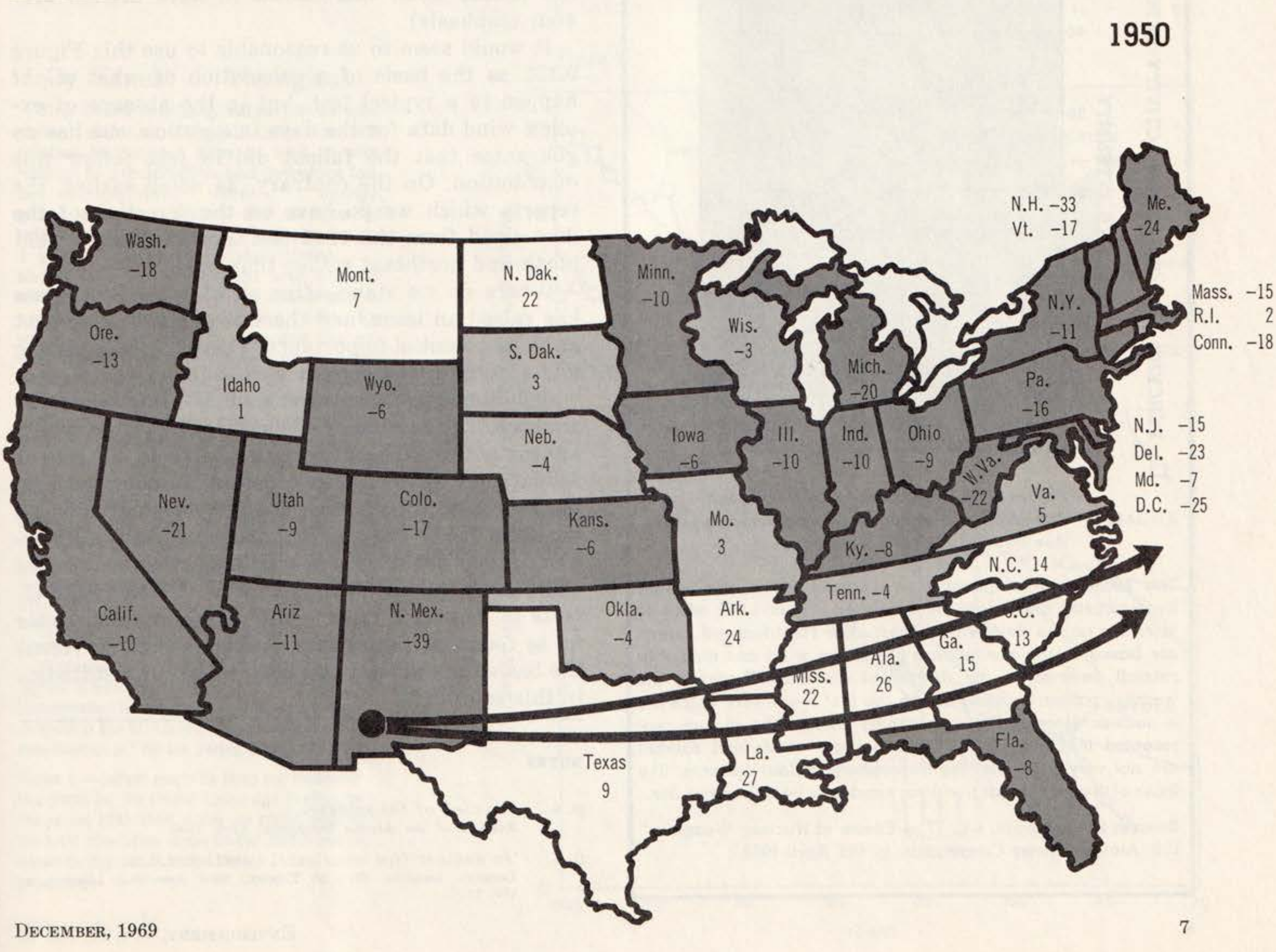
1946



Department of Environmental Health, Palo Alto Medical Clinic), in articles in the *New Scientist* (2 October 1969) and *Bulletin of the Atomic Scientists* (October 1969) goes into great detail. He criticizes details in Sternglass's analysis, including the assertion that there has been a great difference in general fallout levels across the U.S. He queries Sternglass's sources of information. (For example, the strontium 90 levels which Sternglass displays from 1953 are questioned. Sagan correctly asserts that the national milk surveillance program did not start until 1957; only scattered data existed before that time.) He attacks Sternglass's interpretation of the experiments of Luning and Nilsson in Sweden, which involved the injection of strontium 90 into mice, and Luning himself is quoted in *Science* (10 October 1969) as disputing Sternglass's interpretation.

A detailed statistical rebuttal has come from a group at the Bio-Medical Division of the Lawrence Radiation Laboratory, Livermore. Drs. Arthur Tamplin, Yvonne Ricker, and Marguerite Longmate, in the course of a seminar published in the December 1969 issue of the *Bulletin of the Atomic Scientists,* have assembled and re-analyzed a great quantity of data. These include fetal deaths for New York dating back to 1920, and show a peak near 1940 which Sternglass has failed to mention. What this group demonstrates clearly is the great influence which poverty has on infant and fetal death rates, and they make a strong plea for the recognition and correction of these problems.

It is instructive to consider one example of the data cited by Tamplin and his co-workers — that of deaths (up to age one) in New York City. For the period 1955-1965, the rate for each of the three racial groups (nonwhite, Puerto Rican, and white) has remained fairly steady at 40, 30 and 20 per thousand live births. But during this period, the fraction of white births dropped from 73 percent of the total to 59 percent of the total. As a result, the overall average death rate for the city rose from 24.6 to 27 per thousand live births, due simply to the changing population make-up, yet the mortality rate for each group has scarcely changed. The point which the Livermore group makes is that an average may be too coarse a measure which can hide several competing effects, and that these need to be recognized before averages are compared.



Finally, we would like to return to Sternglass's discussion of the data which he has shown in Figures 4 and 5. In describing these figures in the April issue of the *Bulletin of the Atomic Scientists,* he says that:

Thus, the excess mortality is seen to be relatively low in the dry parts of northern Texas over which the high-altitude portion of the fallout passed, reaching a maximum where it first encountered the region of heavy rainfalls to the east of the Mississippi, namely in Arkansas, where the mean annual rainfall is 47 inches compared with 21 inches in northern Texas. Beyond this point, the excess mortality is seen to decease with increasing distance exactly in agreement with the known rate of decrease of radioactivity from tropospheric tests, as plotted in Figure 9.153, p. 480, in "The Effects of Nuclear Weapons."

Because of its importance for his analysis, we reproduce on this page the appropriate passage from "The Effects of Nuclear Weapons" in full. (It is cited as reference 8 in the following article by Sternglass.) It will be noted that the graph displays an "idealized representation," and that the "weather pattern existing during the first few weeks following a nuclear detonation can markedly change the picture." Nowhere does Sternglass refer to any other distribution, actual rather than idealized, which he may have used. Rather, his article reproduced in this issue refers to "the direction in which the fallout cloud was *known* to have drifted off" (our emphasis).

It would seem to us reasonable to use this Figure 9.153 as the basis of a calculation of what *might* happen in a typical test, but in the absence of explicit wind data for the days in question, one has no guarantee that the fallout did in fact follow this distribution. On the contrary, as noted earlier, the reports which we do have on the direction of the dust cloud from the 1945 test indicate that it went north and northeast rather than east.

Where do we stand after all of this? Sternglass has raised an issue, and there is general agreement as to its potential importance. There has been strong and specific disagreement with some of the figures which Sternglass has used and of his methods of analysis. The balance of evidence, at this time, would appear not to support Sternglass's thesis. Effects of fallout may yet be detected; other factors, such as poverty (and the ability to afford adequate medical care and food) are clearly important. As the Livermore group put it, "the Sternglass article . . . should cause us to take a serious look at the potential effects of radiation from whatever source and cause us to focus on the serious problems that represent the basis for the fetal and infant mortality statistics in this country." □

9.153 An idealized representation of the possible tropospheric fallout distribution from a detonation in the temperate zone is given in Figure 9.153, in which the ordinates refer to the activity of isotopes having average lives of at least a month. One curve shows the variation of the relative activity of the deposited material with distance along the downward fallout axis; it has a steep slope because the particles spread farther and farther from the axis, and so cover larger areas, as the distance from ground zero increases. If total activity were being considered, including that of isotopes of short life, the relative intensity would fall off even more sharply with distance because of the decay occurring before the particles descended to earth.

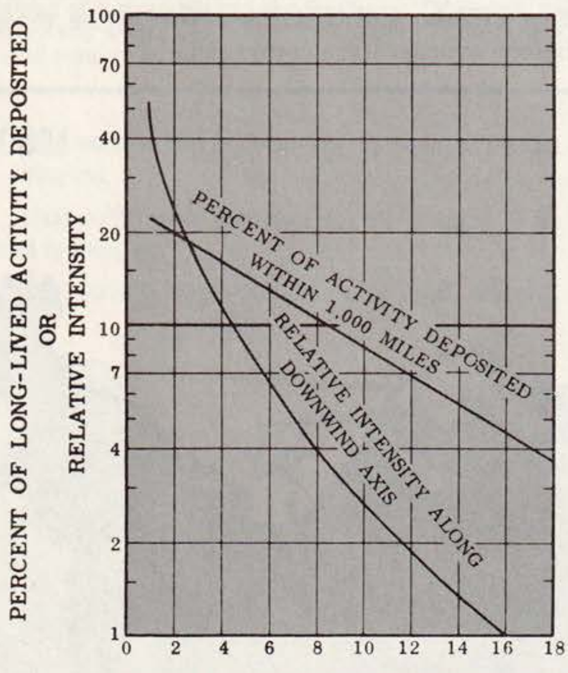


Figure 9.153. Percentage of long-lived activity deposited in troposphere and relative intensity downwind as function of distance.

The second curve indicates the percentage of the longer lived activity that might be deposited within 1,000 miles of locations on the downwind fallout axis. The idealized curves are based on the assumptions of uniform wind and moderate rainfall patterns in the downwind direction. However, the weather pattern existing during the first few weeks following a nuclear detonation can markedly change the picture represented in Figure 9.153. Since uniform winds and rainfall are not very probable, the tropospheric fallout patterns, like those of the early fallout, will vary and may be quite irregular.

Source: S. Glasstone, ed., "The Effects of Nuclear Weapons," U.S. Atomic Energy Commission, p. 480, April 1962.

NOTES

p. 4. *"In view of the evidence. . ."*
Bulletin of the Atomic Scientists, April 1969.

p. 5. *'In another five minutes. . . . northeast."*
Lamont, Lansing, **Day of Trinity,** New American Library, p. 185, 1966.

[Editor's Note: The following text and figures are part of a much longer paper which Dr. Sternglass delivered at a symposium on the Radiobiology of the Fetal and Juvenile Mammal, at Richland, Washington, May 5 through 9, 1969. This portion of his paper presents the claims which are discussed in the preceding article and which have been the subject of some publicity. It is presented here with Dr. Sternglass's permission so that our readers may have an accurate statement of his position. **Environment** and its publisher, the Comittee for Environmental Information, assume no responsibility for the accuracy of this material.]

INFANT MORTALITY

By Ernest J. Sternglass

The infant mortality rates for various states[1] differing in geographic location relative to the test sites as well as with respect to precipitation and therefore fallout accumulation[2,3] were . . . investigated to see whether the decline of infant mortality rates for infants up to 1 year of age in the United States . . . shows . . . an association with nuclear weapons testing. The most direct test is provided in the St. Louis, Mo., area, for which it is possible to compare the excess infant mortality above the expected rates, as determined for the 1935 to 1950 trend line, with the actual Sr 90 content of deciduous molars of children born in a given area,[4] as shown in Figure 1.

The two curves are closely parallel, and the excess mortality rises somewhat earlier than the Sr 90 during the first few years of the tests in Nevada when the short-lived Sr 89 was proportionately more important than for the later high-megatonnage Pacific tests that dominated after 1955.

Figure 1

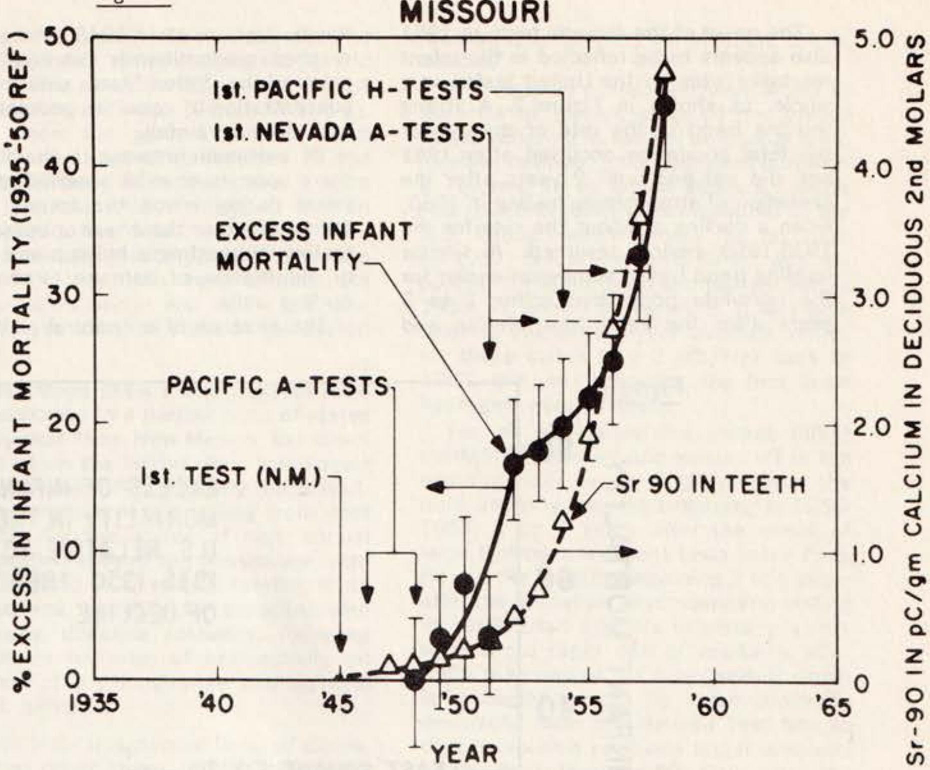


Figure 1 — Excess infant mortality (0 to 1 year) in Missouri relative to the 1935-1950 rate of decline compared with the change in Sr 90 concentration in deciduous second molars for children in the St. Louis area as reported by Rosenthal et al.[4] for the period 1948 to 1953.

Figure 2

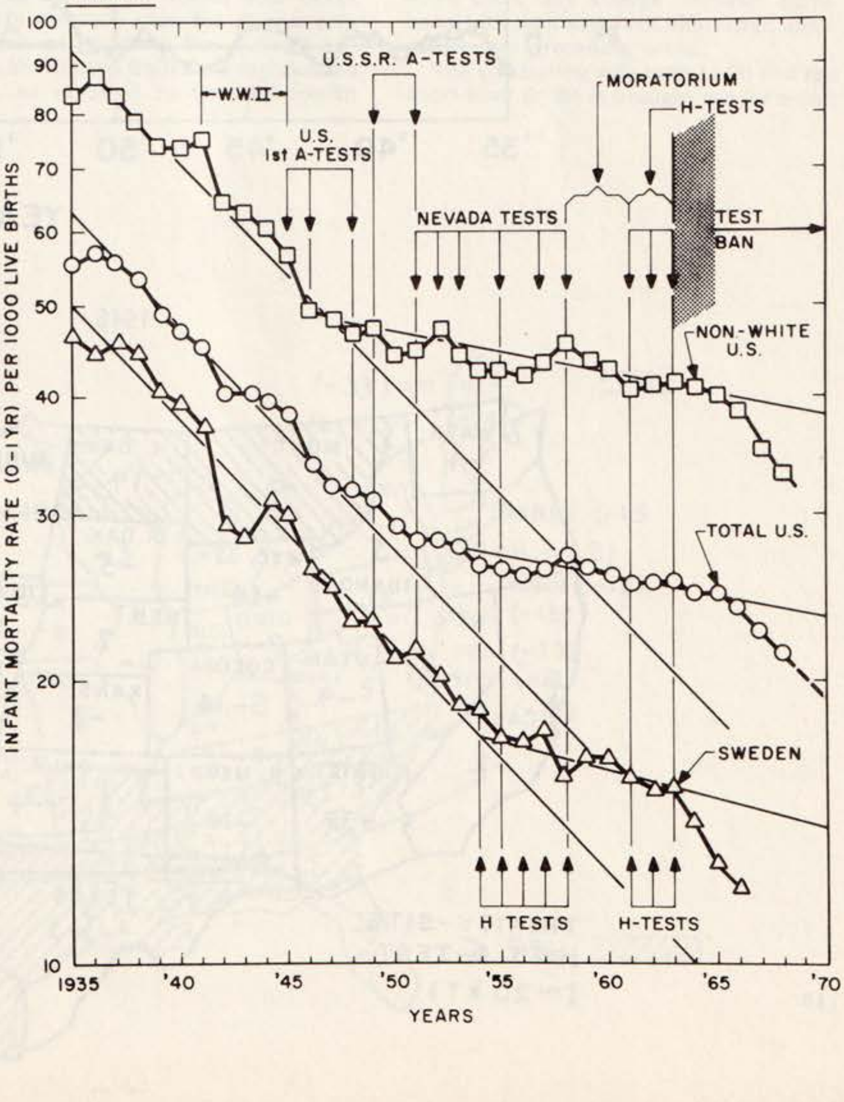


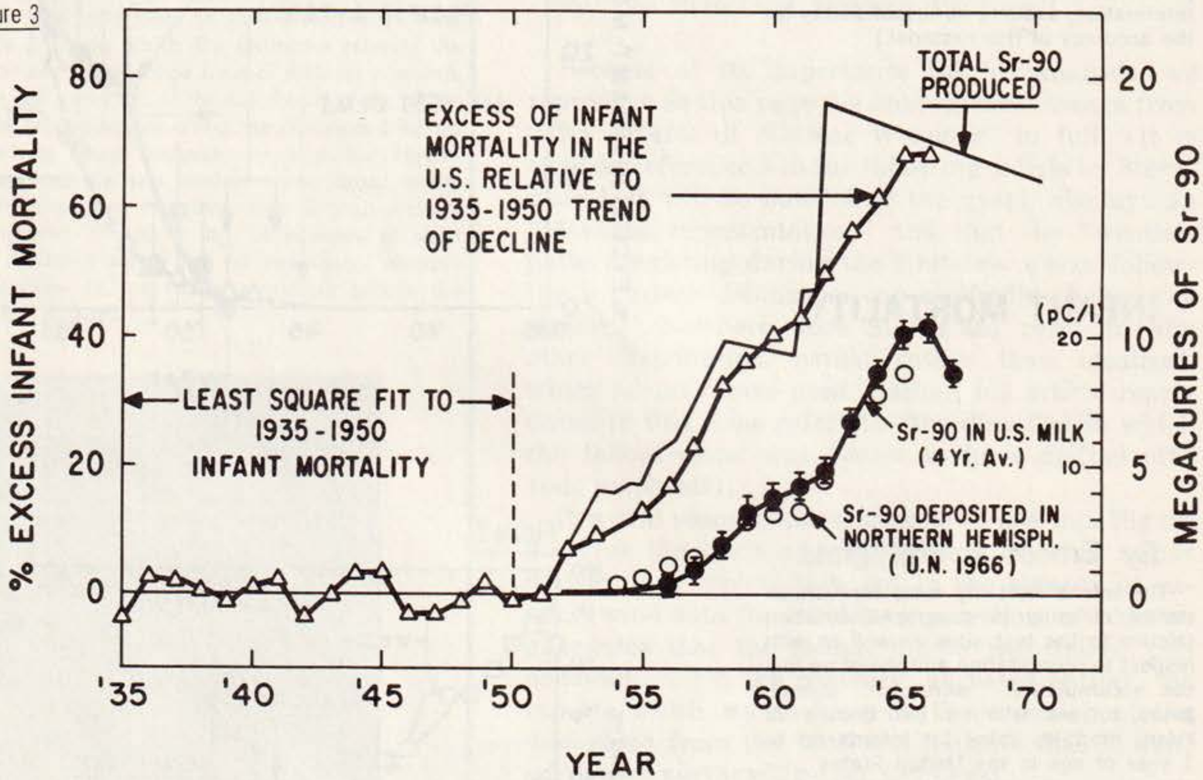
Figure 2 — Infant mortality rates per thousand live births for the United States and Sweden for the period 1935-1968. Rates are shown both for the total population of the United States and the nonwhite population of the United States separately.

The onset of the Nevada tests in 1951 also appears to be reflected in the infant mortality rates for the United States as a whole, as shown in Figure 2. A strong leveling trend in the rate of decline for the total popuation occurred after 1951 and did not end until 2 years after the cessation of atmospheric testing in 1963, when a decline at about the rate for the 1935-1950 period resumed. A similar leveling trend began somewhat earlier for the nonwhite population within 2 to 3 years after the early New Mexico and Pacific tests of 1945-1948, whose fallout reached predominantly the southern regions of the United States with their high concentration of nonwhite population and high annual rainfall.

Of particular interest is the fact that there appears to exist a period of 3 to 5 years during which the trends change following either the onset or cessation of testing, suggesting a buildup and healing or elimination of damage to the reproductive cells.

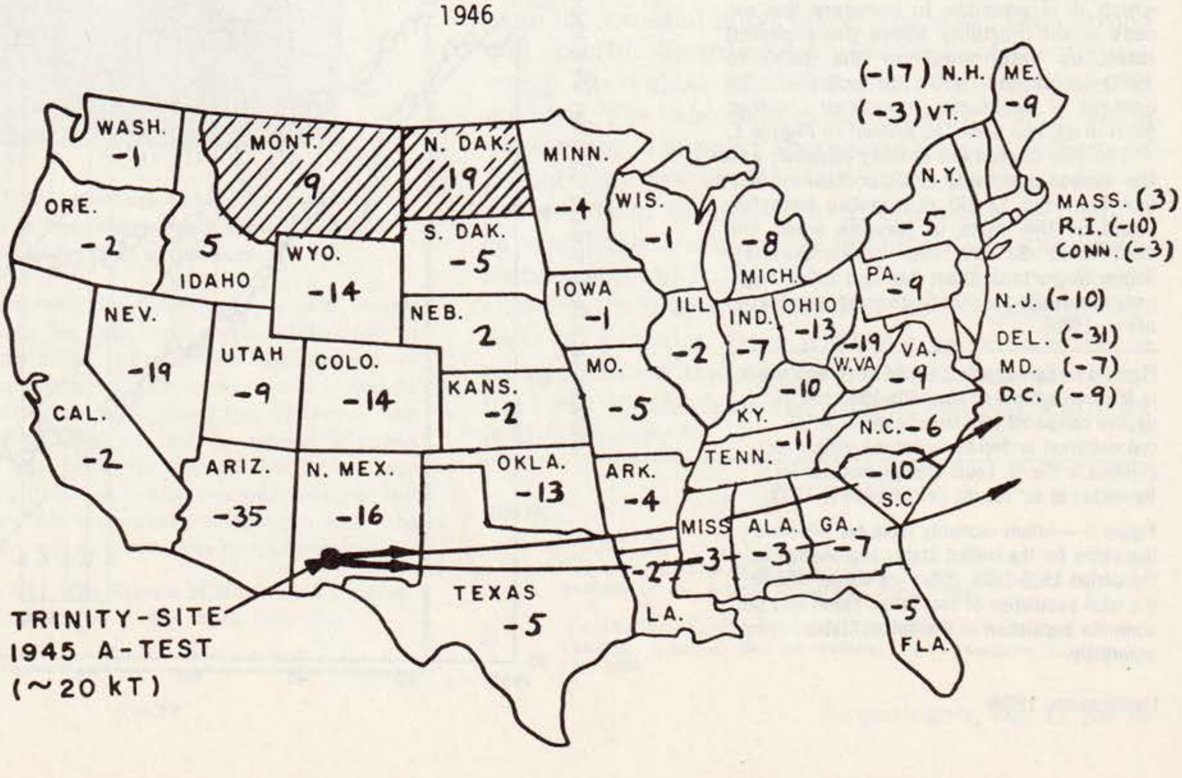
The absence of a "natural plateau" in the attainable infant mortality rate near 20 to 25 per 1,000 live births for the United States as a whole is not only indicated by a resumption of the decline in mortality rates after 1965 but it is also supported by the fact that in six European countries with advanced medical care comparable to that in the United States, namely, Denmark, England and Wales, the Netherlands, Norway, Scotland, and Sweden, the infant mortality rate continued downward so that the rates for all these countries fell below that of the

Figure 3



1946

Figure 4



United States by 1964, despite a leveling trend in these European countries beginning with the onset of large hydrogen weapons testing in the late 1950's, as shown for Sweden in Figure 2. The lowest value, that for Sweden, reached 14.2 by 1964, when the U.S. rate was still 24.8 per 1000 live births.

The degree of correlation of the leveling of infant mortality for the United States and the increase of Sr 90 produced by large weapons testing is shown in Figure 3. In this figure the computer-fitted mortality rates relative to the 1935-1950 period have been plotted, together with the amounts of Sr 90 released,[5] the amount deposited in the northern hemisphere,[6] and the amount measured in the U.S. milk[7] averaged over a 4-year period, in accordance with the 3 to 5-year buildup noted in Figure 2.

Figure 3 — Percent excess infant mortality relative to the 1935-1950 regression line for the period 1950 to 1966. Also plotted is the total amount of Sr 90 produced, the Sr. 90 deposited in the northern hemisphere, and the 4-year Sr 90 average content in U.S. milk.

Figures 4 & 5 — Geographical distribution of excess infant mortality in the United States relative to the values expected on the basis of the 1940-1945 rate of decline. (4) For 1946, 1 year after the test in New Mexico. (5) For 1950, 5 years after the test. Note the absence of any evidence for a direct radiation effect in utero or early infancy in the 1946 plot, suggesting that the major effect is genetic in nature. Also note the consistent excess in the north central states known to have had high Sr 90 levels accumulated by 1950-1958.

The 3- to 5-year delay in the peak of infant mortality, which suggests a genetic rather than a direct somatic effect, is best illustrated by the maps (Figures 4 and 5), which show the percent excess infant mortality for each state relative to the 1940-1945 trend of decline 1 and 5 years after the first atomic weapons test in Alamogordo, New Mex., in 1945. A computer-produced least-squares fit to the 1940-1945 trend was used to calculate the deviation above and below the projected trend for each state of the United States.

These maps show that an excess mortality occurred in a narrow band of states directly east from New Mexico, the direction in which the fallout cloud was known to have drifted off, carried by the prevailing high-altitude winds moving from west to east. For the states of high annual precipitation east of the Mississippi, with more than 40 in. of annual rainfall, there is a general tendency for a decline with increasing distance eastward, following the known behavior of radioactivity on the axis of the long-range tropospheric fallout patterns.[8]

Aside from this narrow band of states, only two other states in the continental United States showed infant mortality excesses greater than 5%, namely, Montana and North Dakota. This excess can be correlated with the peculiar meteorological conditions that have caused the North Central United States near North Dakota to generally show the highest concentration of Sr 90 in the milk of any area in the United States throughout the 1950's, as reported by the AEC Health and Safety Laboratory for Mandan, North Dakota.[9]

The detailed correlation with Sr 90 in the milk of various areas of the United States differing in rainfall and geographic location relative to the test sites is shown in Figure 6 for six typical states for which milk concentrations were measured by the U.S. Public Health Service[7] as far back as 1957. Since very little Sr 90 was deposited in the northern hemisphere before 1955, as shown by Figure 3, it was possible to calculate 4-year average values for these states to ±2 pCi/liter back to 1955, the year following the first large hydrogen weapon tests.

For all six states the excess infant mortality increased and leveled off in the same manner as the Sr 90 levels in the milk, showing the rise beginning in 1956-1957, 3 to 4 years after the onset of large hydrogen weapons tests in the Pacific and the leveling beginning 3 to 4 years after the cessation of atmospheric testing in 1963. Utah appears to show a somewhat more rapid rise of mortality after 1955 than any of the other states, which is probably due to its close proximity downwind from the Nevada Test Site so that it received relatively larger amounts of the short-lived Sr 89. Only after the cessation of all atmospheric tests in Nevada did the Utah infant mortality begin to follow the Sr 90 levels as closely as in the other states, except for the most recent year for which data is available when there was a large increase, correlated with high values of short-lived activities in the preceding years.

The correlation with both Sr 90 and the short-lived Sr 89 is brought out by a plot

1950

Figure 5

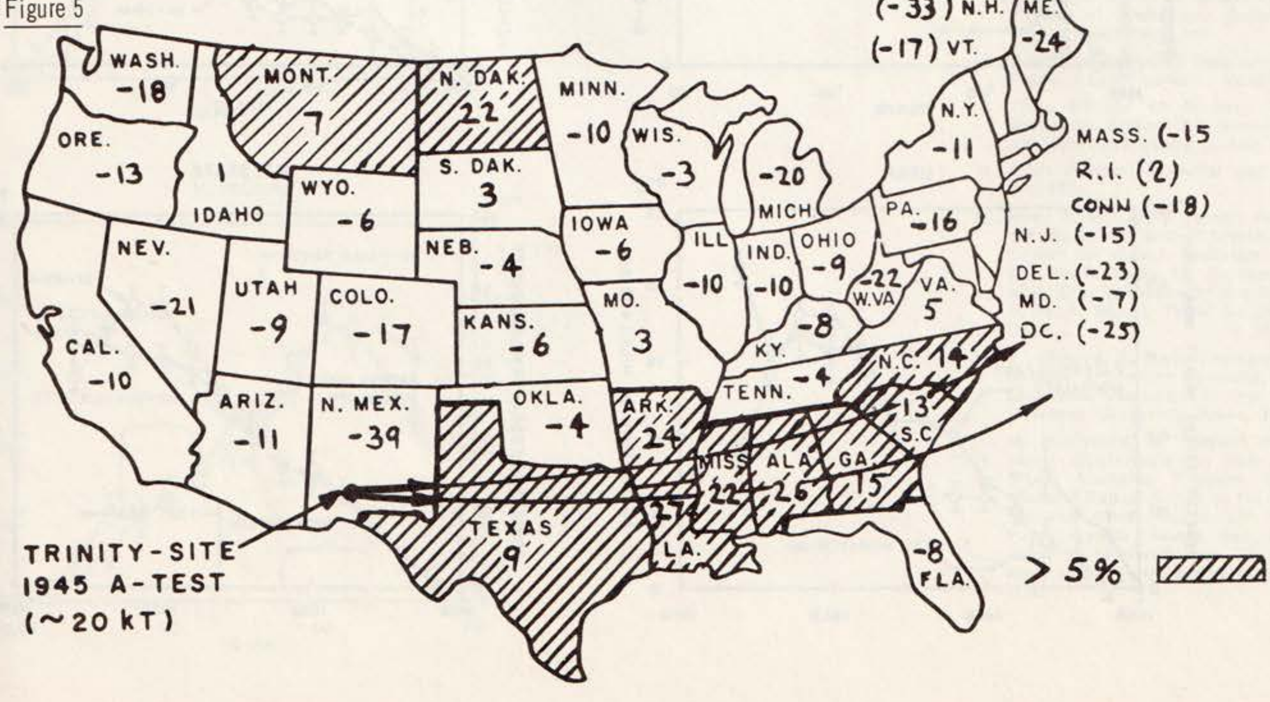


Figure 6 — Percent excess infant mortality (0 to 1 year) and 4-year average Sr 90 content of milk for Georgia, Missouri, Utah, Illinois, New York, and Texas. The excess mortality rate has been calculated relative to the 1955 value, declining at the 1935-1950 rate of decrease before major weapons testing.

Figure 7 — Excess infant mortality in the United States relative to the 1955 value declining at the 1935-1950 rate of decline vs. the Sr 90 activity in the milk, with and without the added contribution due to (1/10) of the Sr 89 activity. The activities, in picocuries per liter, are 4-year moving averages based on the Public Health Service Pasteurized Milk Network Measurements reported in Radiation Health Data and Reports.

Figure 7

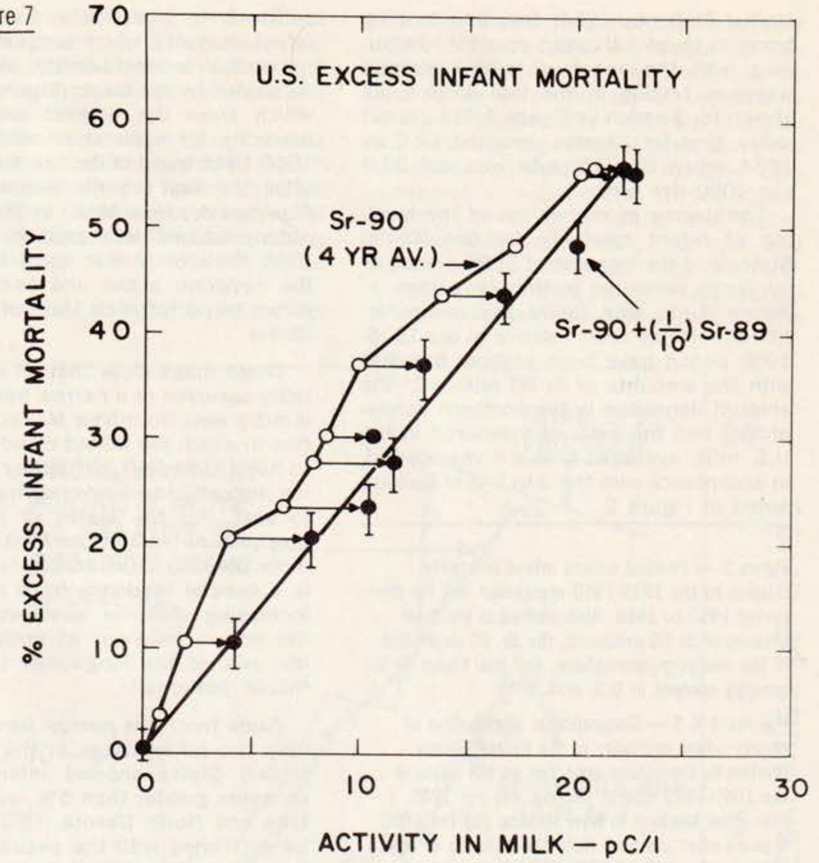
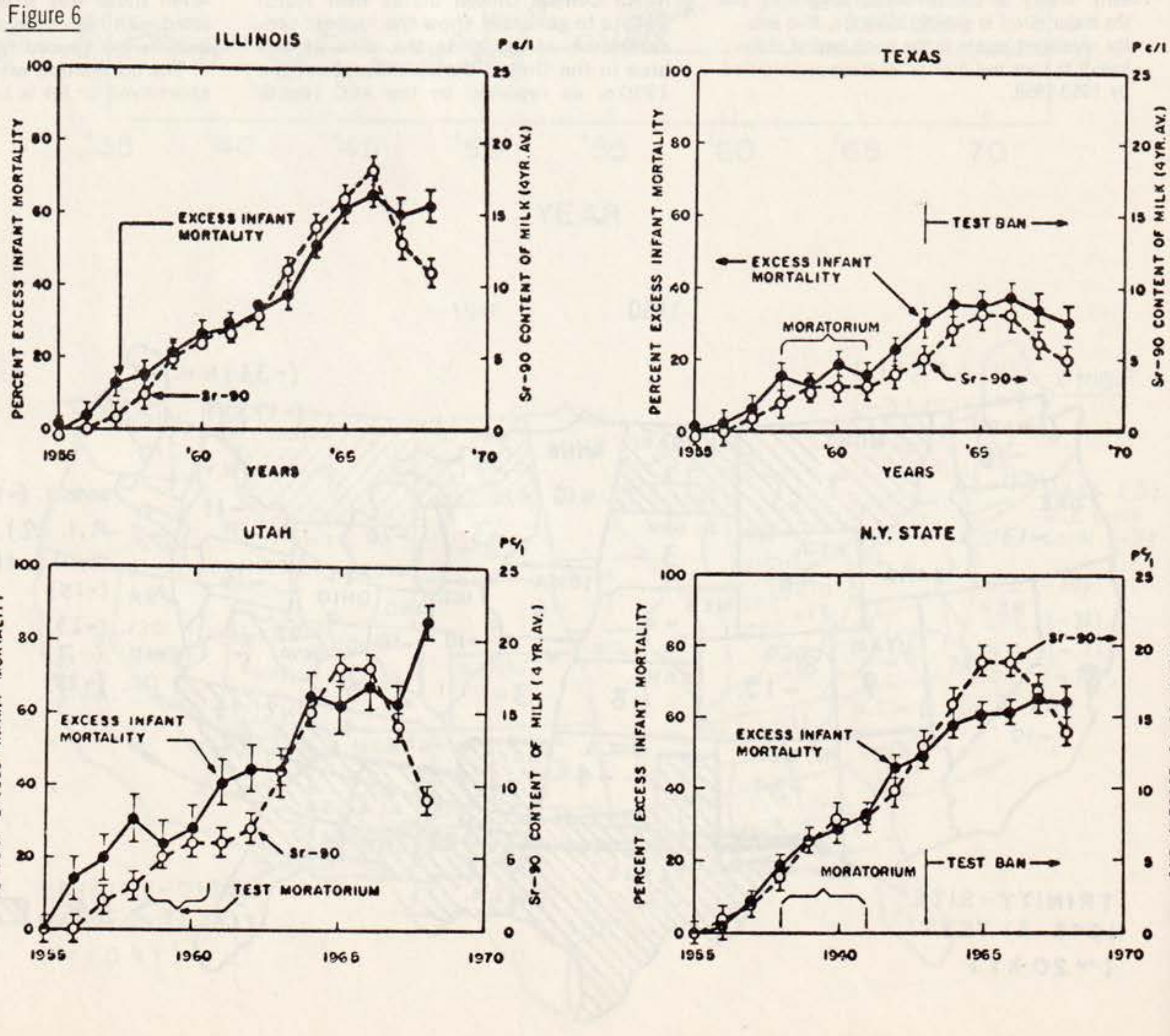


Figure 6



of the excess infant mortality for the United States as a whole against the Sr 90 content in the milk for the period when data on both Sr 90 and Sr 89 were available. The excess infant mortality relative to 1955, declining at the computer-fitted 1935-1950 rate, is plotted against the 4-year moving average Sr 90 concentration in Figure 7 as well as against the combination of Sr 90 plus (1/10) of the Sr 89 activity, where the factor (1/10) is used by the Federal Radiation Council to correct for the lesser biological importance of the more rapidly decaying Sr 89 (half-life of 50 days vs. 28 years for Sr 90).

Apparently the proportionality between the activity in the milk and the excess infant mortality becomes more nearly linear when the effect of Sr 89 is added to the activity of Sr 90 alone, just as suggested by the Utah data in Figure 6.

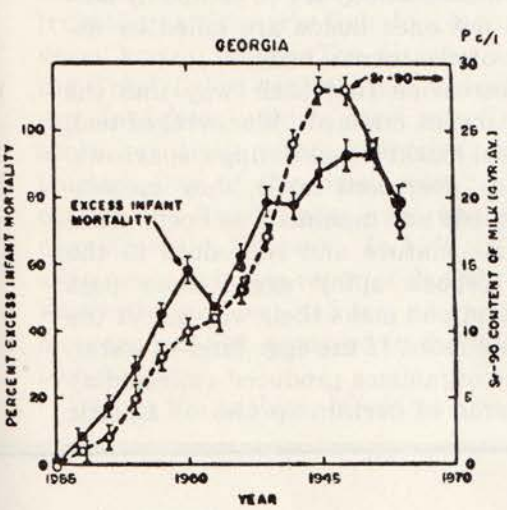
The fact that Sr 90, aside from concentrating in the bone, also appears to produce genetic damage, which expresses itself in excess fetal deaths when injected into the male parent animal before reproduction, suggests that the surprisingly strong effects of fallout on the human fetus and infant may be largely of genetic origin, involving the incorporation of Sr 90 into the genetic material. The doubling dose for chromosomal damage to human cells may be as low as 1 rad, consistent with the recent evidence for an increase in childhood leukemia many years after the irradiation of either parent at diagnostic X-ray levels. Both the high sensitivity and the delay in onset suggest that both excess fetal and infant deaths may be primarily caused by chromosomal damage produced a year or more before conception or in the early stages in the development of the reproductive cells.

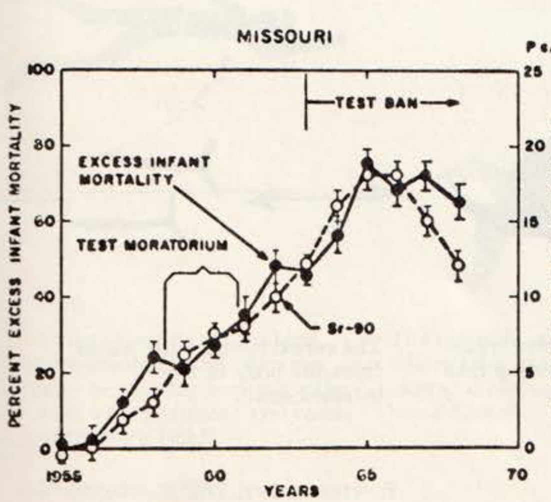
Since radiation given to the early embryo is also known to result in the birth of underweight offspring, the observed increase in infant mortality could also at least in part be understood in terms of a direct radiation effect since immaturity and low birth weight are widely regarded as almost able to account for the increased infant mortality in the United States because of their effect on the infant's ability to fight off diseases.[10,11]

No other explanation for the well-known decrease in the rate of decline for infant mortality in the United States as compared to other countries of equally low mortality rates has so far been found,[10,11] despite a worldwide effort by public health organizations to understand the origin of leveling in fetal, infant, and childhood mortality which began in the United States and which has by now started to affect the entire world. As pointed out in the summary of a special International Conference on the Perinatal and Infant Mortality Problem of the United States[12] held May 13-14, 1965, there seems to be:

> . . . no simple, concise explanation for the leveling off or for the unfavorable position of the infant mortality rate in the United States. No single statistical, demographic, or medical factor appeared to account for the international differences observed in the perinatal and infant mortality rates.

There is accordingly strong circumstantial evidence in the correlation of excesses in the infant and fetal death rate with nuclear testing and Sr 90 concentrations in the environment, the food, and the bones of the fetus and infant that the human ova, spermatogonia, embryo, and fetus may be considerably more sensitive to protracted internal radiation from such radioisotopes as Sr 89 and Sr 90 than had been expected on the basis of external radiation to animals or observations on children X-rayed in utero. □





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