Although there was a tendency for the 7-year-old group to lose and for the 6- and 8-year-old groups to increase some of their gains over a month, the rank order of the age groups with respect to their level of performance was the same on all tests. (Statistically this was shown by an Age × Testing interaction which was not significant.) Assessment of the number of clues given at each age level (also by means of analysis of variance) indicated that there were significant differences ($p < .01$) between the mean number of training clues required at each age level and that the mean number of clues required was inversely related to age. At each age level the mean number of clues required was: age 6, 13.5; age 7, 12.0; age 8, 8.7 (see Fig. 2). Sex differences were also checked by analysis of variance and were found to be not significant.

Some investigators (*3*) concerned with perceptual learning have argued that verbal mediation, rather than the maturation of perceptual structures, can account for age differences in the acquisition of perceptual skills. In our study verbal mediation was employed by all the children although its effects were not the same at different age levels. The majority of the 8-year-old youngsters were able to use the verbal clues to reverse figure and ground and to attain and maintain the highest level of performance. For many of the 6- and 7-year-old children, however, the verbal clues were not sufficient and they required the shield in order to reverse figure and ground. In addition, many of the younger children remembered (from their training on form B) that they had seen "faces" or "animals" in the cards and then claimed they saw them in form A. They were, however, unable to point them out. Thus, the younger children were unable to reverse figure and ground despite their appropriate use of verbal mediation. The ineffectiveness of correct verbal mediation in young children has been noted previously by other investigators (*4*) although they have not stressed its maturational implications.

In our study the influence of experience was suggested by the finding that all the children improved greatly with special training in reversing figure and ground, while the influence of maturation was suggested by the finding that 6- and 7-year-old children required more intense teaching and reached a lower level of performance than did the 8-year-old children. Although our findings do not prove Piaget's developmental hypothesis regarding perception, they are consistent with the cross-sectional observations he reported and upon which he based his hypothesis.

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Nevada Test Fallout and Radioiodine in Milk

Abstract. The iodine-131 dosage to infant thyroids as a result of Nevada testing is evaluated. The case of heavy fallout in the Troy, N.Y., area on 26 April 1953 is cited. The possibility is discussed that a thyroid cancer survey would provide a critical test of linear response versus threshold theory for radiation injury to tissue.

The resumption of nuclear testing at the AEC's Nevada Test Site has resulted in the injection of fission products into the air mass over the U.S. continent. The purpose of this communication is to call attention to localized tropospheric fallout of radioiodine as a short-lived contaminant of the milk supply.

A search of the unclassified literature reveals that in past testing at the Nevada Proving Grounds there have been instances of tropospheric fallout involving iodine-131 contamination far in excess of the levels recorded in the United States as a result of Soviet and U.S. off-continent tests during 1961–62. Such fallouts occurred in the Salt Lake City, New York, Chicago, Rochester, and Troy areas (*1*). Data pertaining to the Troy, N.Y., fallout are detailed enough to permit an estimate of the radioiodine hazard. Emphasis will be placed upon the 8-day iodine-131 activity as a contaminant of the milk supply. The presence of shorter-lived radioiodine and radiation dosage due to inhalation and solid food ingestion is not considered here.

On Sunday, 26 April 1953 a rain-out of radioactive debris occurred over Troy, N.Y. H. M. Clark of Rensselaer Polytechnic Institute reported a gamma radiation intensity of 0.4 mr/hr 1.1 days after arrival of the debris (*2*). In addition, a surface contamination of 1.6×10^7 disintegrations per minute per square foot was measured, corresponding to the activity 36 hours after detonation of the Simon test in Nevada. This explosion took place in the atmosphere (the bomb was mounted on a 300-foot metal tower) and produced a fission yield which has been reported as 43 kilotons (*3*) and also as 52 kilotons (*4*). The top of the bomb cloud reached an altitude of 45,000 feet, and its base was defined at 31,000 feet. The tropopause at the time was at 38,000 feet so that much of the cloud was trapped in the lower atmosphere.

The cloud trajectory took the radioactive debris eastward on an arc path over Pennsylvania, the Hudson Valley, southern Vermont, and Massachusetts (*5*). Severe rainstorms probably produced concentrations of fallout in these states, but the monitoring network was of too coarse a grid to define these fallouts. However, the Troy, N.Y., area was surveyed by an aircraft flying at 500 feet above the terrain on 1 May 1953. The reports of the Simon fallout were classified Secret (*6*). It seems quite probable that the extent of the contamination was considerable (*7*); it is also likely that contamination levels elsewhere exceeded those found in Troy.

I estimate that the level of iodine-131 contamination in Troy, N.Y., was in the range of 2 to 4 curies per square mile or, roughly, that 1/1,000,000 of the Simon test radioactivity fell on 1 square mile. This corresponds to approximately 1 $\mu c/m^2$. A single square inch of plant surface would be exposed to a fallout of 650 $\mu\mu c$ of iodine-131. Thus, leafy edibles marketed promptly after such a fallout could involve a substantial ingestion hazard. However, fresh milk is the most convenient food product to monitor, and it is also the main contributor to the diet of many infants. A pasture level of 1 $\mu c/m^2$ may be translated into a milk contamination of 100,000 $\mu\mu c$/liter. This is based

upon British experience (*8*) with the iodine release (*9*) from the Windscale plant No. 1 on 10 October 1957.

Individuals in the 6-to-18-month age group would be expected to take up about 30 percent of the iodine-131 and retain it in a 2-gram thyroid (*10*). If these individuals consume 1 liter (*11*) of fresh milk per day, a thyroid dose (*12*) of 0.5 rad per year would be sustained if the milk averages 80 $\mu\mu$c/liter. Given a single-shot contamination like that of Troy, individuals drinking milk from the milkshed (assuming the cows received no dry feed) could have received a total dose of up to 30 rad. Depending upon the specific contamination of the milkshed and how the milk was pooled, a large fraction of the 0.5-to-1.5-year-olds (some 10,000 individuals) in the Troy-Albany-Schenectady area would have been at risk. If we take a 10-rad dose as a conservative estimate and assume that 10,000 infants were exposed, then the population dose is 100,000 infant-rads.

E. B. Lewis has estimated that a tenfold-higher dose of 10^6 infant-rads would produce about 10 to 100 cases of thyroid cancer over the first 20 years of the exposed population (*13*). Currently, in the case of Troy, N.Y., the 1953 fallout might yield up to five cases of thyroid cancer if the dose-response curve is linear and no cases if a threshold exists above 10 rads. The National Office of Vital Statistics provides the figure of 0.6 case of thyroid cancer per 100,000 per year. In the case of Troy, one would, therefore, expect one case or less of thyroid cancer due to spontaneous causes. It would appear useful to have the Public Health Service conduct a thyroid survey of the 9–11-year age bracket of those who were resident in the Troy-Albany-Schenectady area during April and May 1953. The 7–9- and 11–13-year age groups could serve as control groups for the survey. Additional surveys might be made in the Salt Lake City area. Should a statistically significant number of thyroid cancers be discovered and the case histories correlate with the intake of fresh milk in the April-May period, the results could be of critical importance to the linear response theory. Even though the delay time involved in the appearance of thyroid cancer is long and may complicate the study, one must also consider the possibility that fetal uptake of radioiodine from the milk-drinking mother may be associated with a comparable rad dose and a greater radiosensitivity than for the 6-to-18-month group. Thus, babies born in the late summer and autumn of 1953 might have sustained high thyroid dosage, and they would be a critical age group to survey.

The presently accepted annual RPG of 0.5 rad for the infant thyroid has been approached during past years in several U.S. communities (*14*). For the period April 1957 through May 1962, the Committee for Nuclear Information (St. Louis) cites a 1.89 rad total dose for Salt Lake City and 2.34 rad for St. Louis (*15*). In general, this irradiation has been caused by radioiodine deposited by tropospheric fallout from off-continent tests. The combination of Siberian and Pacific test fallout with Nevada fallout makes it probable that some American communities will exceed the annual radiation limits defined by the Federal Radiation Council.

The problem of dealing with milk contamination is complicated by the uncertainties of future contamination. The Federal Radiation Council has stipulated three ranges of contamination and a corresponding "graded scale of action" which involves "consideration of control measures designed to limit intake" (*16*). Range III for iodine-131 has an upper limit of 1000 $\mu\mu$c/liter of milk. This upper limit has been exceeded in certain U.S. milksheds during the past year. For example, milk contamination levels in Utah during July 1962 ran over 2500 $\mu\mu$c/liter (*17*). Such levels are still more than an order of magnitude lower than those which I have estimated for the Troy fallout.

Radioiodine appears to have been underestimated as a radioactive hazard in bomb fallout. Concentration of the agricultural contaminant by grazing cows and the quick transport of short-lived iodine-131 in the food supply and subsequent concentration of the radionuclide in the infant thyroid involves a series of events which deserve more careful study. Even so, the radioiodine dosage to infant thyroids in some localities has exceeded the radiation dosage to any active body organ in humans from nuclear test fallout. Indeed, the level of irradiation may have already reached a point in some areas where biological injury to humans may be associated with fallout.

Control of the iodine-131 hazard can be exercised at the point of injection of the radionuclide into the atmosphere and also at the point of injection of the radionuclide into the food supply. The former involves limitation of nuclear testing and the latter involves countermeasures affecting the farmer and dairy industry. With regard to countermeasures, the issue appears to be complicated administratively (*18*), but technically the short life of iodine-131 allows for alternative use of milk where the time delay in marketing the dairy products effectively eliminates the radiation hazard. However, the dairy farmer may incur financial losses due to nonpremium marketing of grade A milk. Bills have been drafted in Congress to compensate the farmer for justifiable losses. Compensation would also be involved where dairy farmers switch to dry feed, as was the case (*19*) on 23 August 1962 in Minnesota. Amendments (*20*) to the pending farm bill (H.R. 12391) cover such cases.

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9. According to Sir John Cockcroft (in a speech at Cambridge, England, 16 Sept. 1958), the meltdown of uranium in the reactor released about 20,000 c of iodine-131. Milk supply from farms in a 200-mi^2 area downwind from the reactor was discontinued.
10. This is a conservative value. Some investigators stipulate uptake of 45 or 60 percent.
11. A liter of milk per day is probably a little high. Infants who are switched from formula to whole milk generally take three 8-oz bottles per day, and many take an extra evening bottle.
12. Data on thyroid radiation dosage are given in the testimony of G. M. Dunning, in "Biological and Environmental Effects of Nuclear War" (hearings of the Joint Committee on Atomic Energy) (1959), pp. 445–448.

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15. Data are taken from Table 1 of a letter, dated 7 June 1962, from Drs. E. Reiss, Barry Commoner, M. Peterson, K. J. Hohenemser, and J. M. Fowler to Dr. Luther L. Terry, U.S. Surgeon General. The letter is quoted with permission of Dr. Commoner.
16. From "Fallout Surveillance and Protection," (U.S. Public Health Service and Food and Drug Administration press memorandum) (26 Oct. 1961).
17. According to a New York *Times* report (2 Aug. 1962), Dr. G. D. Carlyle Thompson, Utah State Health Director, attributes levels of 1600 and 2050 $\mu\mu$c/lit. (on 20 and 25 July, respectively) to Nevada tests of 6 and 12 July. Dr. Robert C. Pendleton of the University of Utah reports iodine-131 concentrations higher than 2500 $\mu\mu$c/lit. on 14 July (personal communication).
18. See, for example, testimony of R. H. Morgan on "Problems of assessment and initiation of control measures" given before the Joint Committee on Atomic Energy in June 1962.
19. See statement of Senator Hubert H. Humphrey, *Congr. Record* (22 Aug. 1962), p. 16195.
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13 August 1962

Anopheles leucosphyrus Identified as a Vector of Monkey Malaria in Malaya

Abstract. *Anopheles leucosphyrus,* an important vector of human malaria in Sarawak, Borneo, was shown to be infected with *Plasmodium inui* in Malaya by the inoculation of sporozoites into an uninfected rhesus monkey. The mosquito was caught while biting a man, thus demonstrating that it would be possible for a monkey infection to be transmitted to man in nature.

The *Anopheles leucosphyrus* group of mosquitoes includes several important vectors of malaria in southeast Asia. Recognition of their significance was largely due to McArthur (*1*) in North Borneo. His observations refer to what is now known as *A. balabacensis,* the type form of which is an important vector of human malaria in North Borneo, and in the monsoon forest regions to the north of Malaya in Thailand, Burma, Laos, Cambodia, and probably Vietnam. *A. leucosphyrus sensu stricto* appears to have a less wide distribution and according to Colless (*2*) is known only from Sumatra, Malaya, Sarawak, and possibly Indonesian Borneo. It was shown by Zulueta (*3*) to be the principal vector of malaria in the interior of northern Sarawak and is probably also a vector of human malaria in Sumatra and eastern Borneo. Another member of this same group *A. hackeri,* has recently been identified as a vector of the monkey parasite *Plasmodium knowlesi* in Malaya (*4*).

Both *A. leucosphyrus* and a subspecies of *A. balabacensis, A. b. introlatus,* occur in central Malaya but neither are common, and they have never been found in close association with man in the numerous entomological surveys that have been undertaken, principally by Hodgkin (*5*). They are however, known to attack man, and were caught on human bait at ground level and in the forest canopy in hill-forest by Macdonald and Traub (*6*). These observations were of particular interest to our studies on the vectors of monkey malaria and we have also found that *A. leucosphyrus* and *A. balabacensis* are attracted to monkeys and to man both in the canopy and at ground level. They are therefore potentially of the greatest importance should monkey malaria prove to be transmissable to man in nature as it is under laboratory conditions (*7*).

Attempts are being made to determine the vectors of monkey malaria in different localities in Malaya by catching and dissecting the mosquitoes attracted to man and to monkeys and inoculating the sporozoite, when it is encountered, into uninfected rhesus monkeys. Observations extending for over a year in uninhabited hill-forest where both *A. leucosphyrus* and *A. balabacensis* are present had failed to incriminate either species, though one oocyst infection was found in *A. leucosphyrus.* Similar observations at an aborigine village at the head of a narrow rice-valley bordered by jungle-covered hills had given abundant evidence that *A. maculatus* is of overwhelming importance as the vector of human malaria. A few *A. leucosphyrus* adults were caught in the same area on monkey bait. This area was chosen for a series of all-night catches on human bait to determine the biting cycle of *A. maculatus* both inside houses and in the open. Included in the outside catches were nine *A. leucosphyrus* (compared with 901 *A. maculatus*). One *A. leucosphyrus* specimen had sporozoites 12 to 14 μ in length in the glands. The sporozoites were inoculated into an uninfected rhesus monkey (*Macaca mulatta*) intravenously, and into man intradermally. The monkey exhibited an infection 17 days later which has been identified as *Plasmodium inui.* No infection developed in the human volunteer.

Anopheles leucosphyrus has therefore been added to *A. hackeri* as a vector of monkey malaria in Malaya. The finding is of considerable significance since the mosquito was caught in the act of biting a man, showing that it is possible in nature for the same mosquito to feed both on monkey and on man. Though this may not be a common occurrence, a single bite of a mosquito infected with a strain of monkey malaria transmissible to man would be sufficient to reintroduce malaria to a human population from which malaria parasites had been previously eliminated. Many factors are involved in determining whether or not this malaria would persist in the human population.

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9 July 1962

Male Sexual Behavior Induced by Intracranial Electrical Stimulation

Abstract. Electrical brain stimulation in the anterior dorsolateral hypothalamus produced a marked increase in sexual capacity in some male rats. Several measures of sexual behavior, including the length of the postejaculatory refractory period, were significantly affected.

The importance of the role of certain areas of the anterior hypothalamus in the mediation of male sexual behavior has been indicated by studies of ablation, chemical stimulation, and intracranial self-stimulation (*1*). The purpose of our investigation was to determine whether changes in the sexual behavior of male rats could be produced by electrical stimulation of the hypothalamus. Electrodes were permanently implanted