erence score in the postirradiation test (Table 2). Exposure to 30 r was sufficient to negate the previous preference for saccharin, while exposure to 57 r resulted in a striking aversion to saccharin.

The consumption of saccharin and tap water was determined daily for 20 days and then at intervals of 2 to 5 days during the next 40 days. The saccharin preference scores for groups that had saccharin available during irradiation are summarized graphically in Fig. 1. The conditioned aversion to the discriminate fluid was still present 30 days after irradiation, although some extinction was apparent.

The use of saccharin solution in the present study has made it possible to demonstrate the effectiveness of ionizing radiation to act as an unconditioned stimulus in animal behavior. Rats tend to avoid a taste stimulus that has been associated with radiation exposure, although the stimulus is usually preferred. The conditioned aversion to saccharin is relatively radiosensitive, being effected by a 6-hr coupling with a 30-r dose of low-intensity (5 r/hr) gamma radiation. The conditioning appears to be dose-dependent in terms of the strength of saccharin aversion and in the persistence of this aversion.

Although the conditioned aversion in this study is dependent on taste discrimination, it may be symptomatic of broader behavioral disturbances instigated during radiation exposure. If this is true, then it should be possible to detect avoidance behavior with stimuli other than taste. Such studies are now in progress.

The processes through which radiation is capable of operating as an unconditioned stimulus are unknown. Since consummatory behavior is partially a reflection of gastric function, it is plausible to suspect gastrointestinal disturbances as the physiological events that motivate the animal in the learning situation. Gastrointestinal functions are known to be disturbed during irradiation and are responsive to the same magnitude of radiation dose (*3*).

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References and Notes

1. J. Garcia *et al.*, U.S. Naval Radiological Defense Laboratory, Rpt. *USNRDL-TR*-19 (1954).
2. This study was supported in part through funds provided by the School of Aviation Medicine, U.S. Air Force. The opinions or assertions contained herein are the private ones of the authors and are not to be construed as reflecting the official views of the Defense Department.
3. T. Toyama, *Tôhoku J. Exptl. Med.* 22, 196 (1933); R. A. Conard, *Am. J. Physiol.* 165, 375 (1951).

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Intolerance of Dizygotic Human Twins to Reciprocal Skin Homografts

Skin homografts transplanted between two human individuals of ordinary genetic diversity are almost invariably rejected by the host individual (*1*). When homografts are exchanged between monozygotic, or "identical," human twins, however, they survive permanently (*1*). With one possible exception (*2*), the behavior of skin homografts in dizygotic, or "fraternal," human twins has not been reported in the medical literature. Meyer-Burgdorff (*2*) described the rejection of skin homografts in a pair of twins whom he regarded as monozygotic, but the diagnosis of monozygosity was not based on objective criteria.

Skin homografts exchanged between dizygotic twin cattle frequently survive indefinitely (*3*) and behave in all respects like autografts. This is in contrast to the rejection of homografts exchanged between ordinary cattle siblings or between dizygotic twin sheep (*4*). The contrast between cattle and sheep in this respect has been attributed (*5*) to the interchange of fetal blood in cattle twins, as is evidenced by the occurrence of freemartins in cattle. Furthermore, in cattle each member of a dizygotic twin pair usually has two types of red blood cells, a heterogeneity suggestive of an actual transplantation of blood-forming tissues by way of the fetal vascular anastomoses. Such animals are spoken of as erythrocyte chimeras (*3*). At least one such chimera has been described in man (*6*).

The present tests were performed in the hope of determining the zygosity of two pairs of twins that presented difficulty in a twin study on mental deficiency (*7*). Both pairs of twins had identical blood antigens and very similar dermatoglyphic patterns. Blood of all four twins was examined at the Knickerbocker Foundation, for heterogeneity of the red blood cells in respect to the ABO antigens, with negative results. Since in each case one twin was severely defective, both mentally and physically, ordinary morphological criteria of zygosity could not be relied upon. In one set of twins, 13-year-old girls, the defective member had microcephaly of postnatal origin, retrolental fibroplasia, and a symmetrical growth anomaly of the toes. The other set of twins were 11-year-old boys, of whom one was a mongoloid imbecile; the mongoloid had a moderate amount of brown (superficial) eye pigmentation that was lacking in his brother. A more detailed report of these cases is in preparation.

Full-thickness, circular skin homografts were reciprocally transplanted in corresponding defects made on the volar surface of the left forearms of each of the two sets of twins. Follow-up examinations made through the ninth week after transplantation confirmed survival of the homografts in the twin girls, indicating a probable monozygotic relationship. Between the 18th and 22nd postoperative days in the twin brothers, however, a sudden violent rejection of the skin homografts occurred. This was evidenced by a marked induration, redness, vascular thromboses, hemorrhage, eventual gangrene, and rapid sloughing of the entire full-thickness of skin in both twins. Except for this relatively delayed reaction, the phenomena observed were identical to those associated with the sloughing of skin homografts between two unrelated individuals (*1*). The result was taken as evidence that the twin brothers were dizygotic in origin.

The senior author is conducting further studies on the behavior of skin homografts in dizygotic twins.

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References and Notes

1. B. O. Rogers, *Plast. Reconstr. Surg.* 5, 269 (1950); *ibid.* 7, 169 (1951); *Transplantation Bull.* 1, 58 (1954); *ibid.* 2, 29 (1955).
2. Meyer-Burgdorff, *Zbl. Chir.* 58, 1337 (1931).
3. D. Anderson *et al.*, *Heredity* 5, 379 (1951).
4. G. H. Lampkin, *Nature* 171, 975 (1953).
5. R. D. Owen, *Science* 102, 400 (1945).
6. I. Dunsford *et al.*, *Brit. Med. J.* II, 81 (1953).
7. This work was part of a study of mental deficiency in twins now in progress at the Department of Medical Genetics of the New York State Psychiatric Institute. The larger project is under the joint supervision of Franz J. Kallman and the Laboratory of Socio-Environmental Studies, Research Branch, National Institute of Mental Health, U.S. Public Health Service. The Psychiatric Institute provided facilities for the skin-grafting operations.

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C^{14}-Acetate Incorporation into Liver Lipids and Glycogen of Irradiated Rats

In vivo differences in C^{14}-acetate incorporation into glycogen and lipids of the liver have been studied in normal and irradiated animals (*1*). Previous investigations into the effects of irradiation have been concerned with either glycogen or fatty acids. Denson *et al.* (*2*) have reported liver glycogen increases in rats starved 24 hr postirradiation, while Ross and Ely (*3*) have shown that liver glycogen appeared within 3 hr after x-ray exposure. However, Fishel (*4*) has reported diminishing glycogen deposition after irradiation, and Prosser (*5*), studying the later effects, observed low liver glycogens. In fasted irradiated rats,