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*).

J. Garcia
D. J. Kimeldorf
R. A. Koelling

Division of Biology and Medicine, U.S. Naval Radiological Defense Laboratory, San Francisco, California

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).

17 March 1955

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.

Blair O. Rogers
Gordon Allen

Department of Plastic Surgery, St. Barnabas Hospital, Newark, New Jersey, and *National Institutes of Health, Bethesda, Maryland*

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.

31 March 1955

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,

Table 1. Effect of irradiation on acetate-C^{14} incorporation into liver glycogen and fatty acids

No. of animals	Dose (r)	Starvation period (hr)	Liver glycogen (%)	Total counts	Liver fatty acids (%)	Total counts
8	0	0	3.4	66	3.7	220
8	0	48	0.5	79	3.8	45
8	1500	48	3.4	203	4.2	410
7	1500	24/24*	2.7	95	3.7	217
8	1500	48/24†	3.7	176	3.7	151

* Animals fasted 24 hr before and after irradiation.
† Animals fasted 48 hr before and 24 hr after irradiation.

Table 2. Effect of irradiation on incorporation of acetate-C^{14} into liver lipid fractions

No. of animals	Dose (r)	Starvation period (hr)	Liver phospholipids (mg)	Total counts	Liver neutral fat (mg)	Total counts
6	0	48	187.1	50	112.1	69
8	1500	48	185.3	51	113.8	142

liver glycogen was found by McKee (*6*) to be higher than in fasted controls. This effect was first ascribed to retarded glycogenolysis. Fasting preliminary to x-ray exposure indicated, however, that the high levels might be the result of glycogen formation. Our studies have pursued this line and have further employed the incorporation of labeled acetate to compare the metabolic activity in irradiated and normal animals.

Coniglio *et al.* (*7*) found an increase in the incorporation of intraperitoneally administered C^{14}-acetate into liver fatty acids of x-rayed animals. Since Neve and Entenman (*8*) observed increases in blood phospholipids, which might be a reflection of liver synthesis, the liver lipids of two groups of animals were fractionated into phospholipids and neutral fat. Thus in these studies interest was also centered on the particular lipid fraction into which acetate incorporation occurred.

Female albino rats weighing 175 ± 15 g were given a single dose of 1500 r with a G.E. Maximar x-ray and were fasted 24 or 48 hr. They were then fed 0.02 mg of sodium acetate-1-C^{14} (0.2 μc) dissolved in 0.5 ml of water. After 2 hr the animals were sacrificed. The livers were isolated, weighed, and immediately placed in hot potassium hydroxide. After the mixture was heated 5 hr the glycogen was obtained by successive precipitation with 60-percent ethanol. The liver fatty acids were extracted with ethyl ether from the acidified ethanol supernatant. The results of these analyses are shown in Table 1.

Significant increases in the percentage of liver glycogen can be seen in all fasted irradiated animals as compared with fasted controls. In the last group, in which the starvation period would have reduced the values comparable to the controls (0.5 percent), the glycogen value of 3.7 percent obtained 24 hr postirradiation could best be explained by synthesis of glycogen. This does not support Denson (*2*) and others who attribute the increased glycogen to a retardation of glycogenolysis but does support McKee's suggestion that liver glycogen after irradiation is produced by glyconeogenesis. Increased synthesis could result from the utilization of fragments released by the cellular breakdown that accompanies x-irradiation.

An accelerated metabolism caused by a greater supply of glycogen-forming intermediates would also explain the increased C^{14}-incorporation into glycogen in the animals fasted 48 hr before irradiation. Hughes and Tolbert (*9*), administering amino acids and carbohydrates, and Morehouse and Searcy (*10*), feeding lipids, have shown that greater amounts of C^{14}-carbon dioxide are expired from irradiated animals than from normal animals. Further investigations are planned to determine the rates of release of C^{14}-carbon dioxide after labeled-acetate feeding.

The total fatty acids of the liver show that irradiation increases the incorporation of C^{14} some tenfold over that of the fasted controls. This could be caused by a net synthesis of fatty acids from acetate, even though the amounts are not sufficient to be seen in increased weight of fat.

In two more groups of animals, the lipid fraction that incorporated the greatest amount of C^{14} was determined. These animals were treated as before, except that the livers were extracted for total lipids. This total lipid was divided into neutral fat (acetone soluble) and phospholipids (acetone insoluble). The results are shown in Table 2.

No differences in the incorporation of the label or in the absolute amounts of phospholipids isolated from the two groups of animals can be seen. Thus it does not appear that irradiation has appreciably affected the synthesis of phospholipids from fatty acids in the liver during the period studied. Although the amount does not increase significantly, the incorporation of C^{14} into the neutral fat of the irradiated animals is about twice that of the normals. This result is consistent with that found for the total fatty acids and could possibly also be explained by a somewhat greater net synthesis of the fatty acids in the neutral fat. The magnitude of the synthesis could be too small in the period studied to be reflected in an increased weight which might further be kept constant by the needs of metabolic processes. From these results it is concluded that irradiation affects the incorporation of labeled acetate into the neutral fat fraction more than into the phospholipid fraction.

Further work is contemplated to give substantiation and elucidation to these observations.

MARGARET G. MOREHOUSE
RONALD L. SEARCY
Department of Biochemistry and Nutrition, University of Southern California, Los Angeles

References and Notes

1. This research was supported by a grant from the U.S. Atomic Energy Commission, contract AT(11-1)-113, project 6, and conducted through the laboratory facilities of the Allan Hancock Foundation.
2. J. R. Denson *et al., Proc. Soc. Exptl. Biol. Med.* 82, 707 (1953).
3. M. H. Ross and J. O. Ely, *J. Cellular, Comp. Physiol.* 37, 163 (1951).
4. E. Fishel, *Schweiz. med. Wochschr.* 71, 764 (1941).
5. C. L. Prosser, quoted by Lourau *et al., J. physiol. (Paris)* 43, 593 (1951).
6. R. W. McKee, *Federation Proc.* 11, 256 (1952).
7. J. Coniglio, *ibid.* 13, 194 (1954).
8. R. A. Neve and C. Entenman, USNRL Rept. AD-307(B), (1951).
9. A. M. Hughes and B. M. Tolbet, UCRL Rept. 2709 (1954).
10. M. G. Morehouse and R. L. Searcy, unpublished data.

9 February 1955

Aerial Blobs

Twinkling of the stars has its origin in the temporary fading of their light and in lateral excursions of their images. These variations in light intensity and position of the stars are caused by disturbances in the earth's atmosphere.

In this paper attention is called to