is a necessary condition for recovery.

The results of both studies in which the animals are tested repeatedly can be interpreted in terms of Zinkin and Miller's alternative explanation, that is, that learning takes place during reexposure which "would depend on there being some minimum retention of the . . . properties of the situation on the first day of testing." The recovery obtained in our study may also be attributed to adaption-habituation phenomena. However, the amnesia observed in animals tested for the first time at intervals longer than 24 hours indicates that retrograde amnesia is apparently permanent.

Note added in proof: The recent report of Luttges and McGaugh (*3*) in which no recovery was observed with repeated tests over periods as long as 1 month suggests that recovery, when it occurs, may be a function of procedural or task variables.

MICHAEL J. HERZ
Department of Psychiatry,
University of California
Medical Center, Los Angeles
HARMAN V. S. PEEKE
Department of Physiology,
University of California
Medical Center, San Francisco

References

1. S. Zinkin and A. J. Miller, *Science* **155**, 102 (1967).
2. H. V. S. Peeke and M. J. Herz, *Proc. Annu. Conv. Amer. Psychol. Ass. 75th* **2**, 85 (1967).
3. M. W. Luttges and J. L. McGaugh, *Science* **156**, 408 (1967).

2 March 1967

The point we wished to make in our article was that, with avoidance latency as the criterion for retention, individual ECS-treated animals were showing more evidence of retention on the second or third day of testing, or both, than on the first day. The interpretation of this effect was intentionally left open, since it was not clear whether the retention was a function of the repeated testing or of the passage of time—but in either case a partial or subthreshold trace must have been present at a time when no sign of retention was elicited by behavioral testing.

While Herz and Peeke's results favor the first explanation, a "shrinkage of amnesia" interpretation may still apply in cases where the interval between learning and ECS is longer than we (and presumably Herz and Peeke) were using. With a longer ECS delay, amnesic effects may reflect a disturbance of retrieval as much as of storage, and such a disturbance could dissipate with time. We are currently investigating this possibility.

On the other hand, ECS administered immediately after learning almost certainly interferes with the actual setting up of the memory trace. Whether or not behavioral retention will appear (in *any* subsequent test) is likely to depend on how much of the original trace manages to survive the ECS, and this in turn may depend on a variety of factors, including the strength and duration of stimulation, the path taken by the current (that is, by means of ear or corneal electrodes), and the nature of the pre-ECS learning trial. Differences in variables of this sort might, for example, explain Luttges and McGaugh's recent failure (*1*) to obtain the recovery effect found by both Herz and Peeke and ourselves.

SHEILA ZINKIN
A. J. MILLER
Psychological Laboratory,
University of Cambridge,
Cambridge, England

Reference

1. M. W. Luttges and J. L. McGaugh, *Science* **156**, 408 (1967).

9 May 1967

Type of Sodium Bond in Mammalian Hair

In a recent report [*Science* **155**, 588 (1967)] G. S. Kennington has argued that sodium is probably present in mammalian hair in two states—a relatively free and a relatively strongly bonded form. His conclusions are based on washing experiments carried out with antelope hair. Sodium-22 incorporated by impregnation could be washed out completely, leaving a sample that still contained sodium, as shown by activation analysis.

Interaction between human hair and solutions of different salts has been under investigation in our institute. The information obtained is important for evaluating the possibility of distinguishing persons by concentrations of trace elements in their hair.

During this work we have observed anomalies in the diffusion of certain elements, but not with sodium. However, our experiments have shown that human hair can concentrate sodium from very dilute aqueous solutions. For instance, a solution of 10 parts of NaCl per million leads to a concentration in hair of 60 ppm. It would, therefore, be extremely difficult to wash hair completely free of sodium because water could easily take up some sodium from the glass vessel. Unfortunately, the end concentration of sodium in Kennington's washed sample is not given. No conclusions can be drawn from the gamma spectrum of the irradiated sample because the irradiation and waiting times were not specified. Therefore, it seems advisable to postpone conclusions concerning the type of sodium bonding until more quantitative data are available.

J. P. W. HOUTMAN
Reactor Instituut, Delft, Netherlands

21 March 1967

Professor Houtman's comments call attention to one of the problems of activation analysis of tissue—that of the pervasive presence of sodium. Sodium is not only normally present in tissue but also may be inadvertently introduced even during careful handling when, for instance, clean forceps touch table space where ungloved hands have previously rested, or, as he suggests, minute amounts of sodium washed from the glass vessel remain in the hair sample that is to be activated. In all my tests I included a blank of filter paper to check for the presence of contaminated water and vessels and to check technical procedures. The spectra of these blanks showed no sodium (or other) residues. Of course it is possible that sodium from these sources is concentrated or held by the hair fiber in a manner different from the way it is held by filter paper fibers, but the sodium-22 experiment would argue against that.

GARTH S. KENNINGTON
Department of Zoology and Physiology,
University of Wyoming, Laramie

1 May 1967