Gill Gigstead, Wisconsin Department of Conservation; George O. Hendrickson, Iowa State College; Lawrence E. Hicks, U. S. Soil Conservation Service; Ralph T. King, University of Minnesota; Aldo Leopold, University of Wisconsin; Frederick C. Lincoln, U. S. Biological Survey; Miles D. Pirnie, W. K. Kellogg Bird Sanctuary, Michigan State College; H. D. Ruhl, Michigan Department of Conservation; George Saunders, Michigan Department of Conservation; R. E. Trippensee, Massachusetts Agricultural College; Farley F. Tubbs, Michigan Department of Conservation; Douglas E. Wade, University of Wisconsin; E. L. Wickliff, Ohio Conservation Division; H. M. Wight, School of Forestry and Conservation, University of Michigan; and R. E. Yeatter, Illinois Natural History Survey.

The Illinois Natural History Survey, as host organization of the meeting, held open house on Thursday night, December 5, and invited conference members and townspeople to inspect its laboratories and offices located on the campus of the University of Illinois, and later to see several reels of new wildlife motion pictures.

The conference voted to make an annual affair of the meeting so successfully initiated at the first parley, not to have a constitution or formal organization, and to preserve the open discussion system which characterized the Urbana gathering. Ann Arbor, Michigan, was selected by the assemblage as the place for the next meeting, and Dr. Samuel A. Graham, of the University of Michigan, was appointed by a special committee to act as chairman for the 1936 conference.

T. H. FRISON

SPECIAL ARTICLES

THE INFLUENCE OF HYPERPNEA AND OF VARIATIONS IN THE O_2- AND CO_2-TENSION OF THE INSPIRED AIR ON WORD-ASSOCIATIONS

IN three preceding papers, Gellhorn and Spiesman[1] have investigated the influence of variations in the O_2- and CO_2-tension in the inspired air and of voluntary hyperpnea on several cortical processes (vision, hearing), as well as on a brain stem reflex (caloric nystagmus). It seemed desirable to extend these investigations to a quantitative study of higher mental processes for two reasons: (1) to improve our understanding of the nervous and mental symptoms following profound anoxemia and similar conditions; (2) to compare the effect of the same factors on physiological cortical processes (vision, hearing) and on one of those which are commonly designated to-day as psychic processes.

The experiments were carried out with the Kent-Rosanoff[2] association test, which consists of 100 words standardized on 1,000 normal persons so that the usualness of response can be expressed quantitatively. Fifty words served as a control and the other fifty words were used in order to study the effect of O^2-lack, etc., on associations. In control experiments carried out on 25 subjects the associations formed to the first 50 words were compared with those obtained from the second 50 words. The associations were divided into four groups corresponding to their frequency in the Kent-Rosanoff tables. The total number of responses was determined for each of the four groups (comprising the individual responses (0-group), and those occurring 1–15, 16–100, and more than 100 times in the frequency tables), and the change between the first and the second 50 associations was expressed in percentage of the former (heavy line in Fig. 1). The

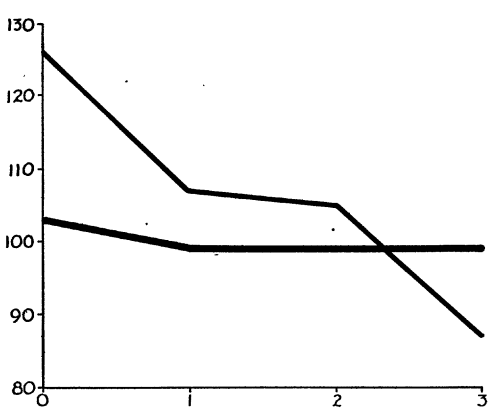

FIG. 1

Ordinate: change in usualness of response between the first and the second 50 words expressed in percentage of the former.

Abscissa: 0 = individual responses, 1, 2, 3 = responses with the frequency 1–15, 16–100, and more than 100 respectively.

Heavy line = control.

Thin line = the effect of 0_2-lack.

figure indicates that the frequency of responses remains practically the same in both groups of 50 words under standard conditions.

Hereafter fifty experiments on O_2-lack were carried out with 31 normal subjects, who inhaled N_2-air mixtures (O_2 between 7.3 per cent. and 11 per cent., in the majority of experiments 8 to 9 per cent.) from a Douglas bag for 6 to 10 minutes.

[1] E. Gellhorn and I. Spiesman, *Proc. Soc. Biol. and Med.*, 32: 46 and 47, 1934; and *Am. Jour. Physiol.*, 112: 519, 620 and 662, 1935.

[2] G. H. Kent and A. J. Rosanoff, *Am. Jour. Insanity*, 67: 37, 1910.

Since we were more interested in any shift which might occur in the usualness and type of association than in the association time, the latter was not determined and the experimental subjects wrote the association words as answers to the stimulus words which were dictated to them. Twenty-nine control and O_2-lack experiments, in which the distribution of the associations according to their frequency was determined by the Kent-Rosanoff tables, were calculated as the control experiments described above. The result represented in the thin line of Fig. 1 is that O_2-lack brings about a marked shift in the type of response toward the more individual reactions. Moreover, it is found that the number of perseverations (repetition of the same response) increases under O_2-lack to an extent inversely proportional to the O_2-concentration inhaled. Finally, it must be mentioned that under such O_2-lack not infrequently entirely irrelevant reactions (dissociations) occur.

Experiments in which the effect of various O_2-concentrations on associations was studied on the same subject proved strikingly that the changes in associations mentioned above are due to O_2-lack, since they gradually increased with decreasing O_2-concentration. One illustration may be given in the following table, which is self-explanatory:

THE INFLUENCE OF O_2-LACK ON ASSOCIATONS. SUBJECT W

	Number of perseverations	Number of dissociations
Control	3	0
9.8 per cent. O_2	7	0
8.65 per cent. O_2	10	3
7.93 per cent. O_2	15	9

CO_2 experiments (6 to 9 per cent.) were carried out under similar conditions with similar results. In general, the CO_2 effect is less than that of O_2-lack.

This holds true, also, for the effects of hyperpnea. But in all three groups of experiments the resulting changes in the association response were the same and consisted in: (1) an increased number of individual and less frequent reactions; (2) an increased number of perseverations; (3) the occurrence of dissociations. It is obvious from these results that the alteration in cortical excitability due to O_2-lack, CO_2-excess and hyperpnea leads to similar changes in vision and hearing, as well as in associations, whereas CO_2-excess and diminution in CO_2 due to hyperpnea have opposite effects on tendon[3] and vestibular[4] reflexes. As to the type of change in associations observed in our experiments, it may be said that it is similar to those observed in some mental diseases.[5] There was no general parallelism between the discomfort felt by the subjects (dyspnea, etc.) and the changes recorded.

E. GELLHORN
S. H. KRAINES

THE DEPARTMENT OF PHYSIOLOGY
AND THE PSYCHIATRIC INSTITUTE,
COLLEGE OF MEDICINE,
UNIVERSITY OF ILLINOIS

THE INFLUENCE OF THE ADRENAL GLANDS ON CALCIUM METABOLISM[1]

IN a previous communication,[2] one of us summarized evidence indicating a functional interrelationship between the adrenal and parathyroid glands. Mention was made of observations on disturbances in calcification of dentin in rats' incisors induced by excess of parathyroid extract. These changes were found to be similar or identical with those which follow bilateral adrenalectomy in rats.

Characteristic disturbances in calcification of dentin occur in the incisors when both adrenal glands are excised, in rats. They are manifested by the presence of globules disseminated throughout the predentin of the middle third of the incisor.

The "globular predentin" stains, with eosin and haematoxylin, like intermediate dentin. It was not present in nearly a thousand rats that were observed in other studies, in which adrenalectomy was not performed, except in three animals that received single large doses of parathyroid extract and were examined 19 hours later.

Other evidences of disturbed calcification in the dentin are deep staining of the labial dentin by haematoxylin and prominent stratification in the lingual dentin. In adrenalectomized animals that survived up to about 10 days the post-operative dentin could be distinguished from the pre-operative by the presence of a deeply stained band corresponding to the portion of dentin that was laid down and calcified about the time of the operation. The presence of this band permits measurement of the post-operative dentin. The organic matrix of the dentin is laid down at the rate of 16 μ daily, therefore, the width of the post-operative dentin, expressed in μ, when divided by 16 will yield the survival period of the animal. The calculated survival period corresponded remarkably with the actual period noted in our experimental records.

In adrenalectomized rats whose survival was prolonged by the presence of accessory adrenal bodies, the characteristic globular predentin was absent. They showed changes similar to those found in rickets, *viz.*, wide predentin (40–84 μ) and prominent inter-

[3] C. E. King, W. E. Garrey and W. R. Bryan, *Am. Jour. Physiol.*, 102: 305, 1932; Strughold and Jörg, *Zeitschr. f. Biol.*, 94: 150, 1933.

[4] Gellhorn and Spiesman, *loc. cit.*

[5] Kent and Rosanoff, *loc. cit.*

[1] From the Department of Histology, College of Dentistry, University of Illinois, and the Physiological Laboratory, University of Chicago. This investigation was