They contain masses of colloid in amounts varying from none to inclusions almost completely filling the cell. The appearance and behavior of these colloid droplets closely resemble those long known in the secretory cells of the thyroid and hypophysis, and these droplets are extruded from the cells in a similar way.

The idea that normal nerve cells may perform the glandular functions of an endocrine organ is so unconventional that a critical attitude, if not skepticism, is to be expected. But the histological evidence marshalled is impressive, and the fact that nerve cells whose axons terminate in an endocrine organ may themselves have an endocrine function is not so anomalous as it seems, when viewed in the light of actual neuroglandular relations in various invertebrates (tunicates, nemerteans, insects, etc.) as revealed by investigations of many competent workers and especially of the Scharrers themselves. They are now attacking the problem from the physiological side, and it is not improbable that these studies may point the way toward the solution of some of the most puzzling problems of endocrinology.

The anatomical part of this work concludes with chapters on the blood vessels of this region by Drs. Finley and Craigie, with findings that seem to favor the hypothesis that the peculiar cells to which reference has just been made are chemoreceptors sensitive to certain chemical constituents of the blood.

In Part II our knowledge of the physiology of this part of the brain is summarized in chapters on cardiovascular regulation (Bronk, Pitts and Larrabee), body temperature (Ranson), pilomotor regulation (Walker), water metabolism (Hare, Gersh and Barbour), fat metabolism (Gildea and Man), gonadotropic functions (Brooks), sexual behavior (Bard), anterior pituitary function (Uotila), gastro-intestinal regulation (Sheehan), vesical activity (Langworthy), effects of analeptic drugs (Masserman), sleep (Harrison), somatic responses (Hinsey).

These papers present an imposing array of carefully controlled experiments by qualified experts, with technical aids which have been available only within the last few years. The net results are still confused and in some cases contradictory, yet the methods are good and further work along these lines is sure to resolve many obscure and controversial questions. The special value of several of these chapters and of the clinical papers which follow in Part III lies in their negative evidence—the exclusion of some supposed functions of the hypothalamus and the determination of "the exact state of our ignorance" concerning some others.

Diseases involving the hypothalamus include some of the gravest and most puzzling disorders with which medical practice is confronted. The clinical studies of Part III summarize the known facts and still unsolved problems.

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SOCIETIES AND MEETINGS

THE SIXTH WASHINGTON CONFERENCE ON THEORETICAL PHYSICS

March 21–23, 1940

"THE Interior of the Earth" was the subject of three days of intensive discussion at the Sixth Annual Conference on Theoretical Physics held in Washington from March 21 to 23, under the joint auspices of the George Washington University and the Carnegie Institution of Washington. A group of fourteen investigators in geophysics and in theoretical physics from various universities in the United States joined a similar number of Washington investigators in a series of informal meetings, in large and small groups, for technical examination of some of the outstanding problems concerning matter in great bulk and under large pressures and temperatures, as found inside the earth. The chief aim of the discussions was to formulate these problems more clearly for future joint efforts.

The first meeting was devoted to the pressure-volume relation at high pressures and associated questions concerning the probable composition and physical state of the earth's deep interior. Professor Fermi introduced the topic. He showed that for pressures higher than about 10^8 atmospheres the pressure-volume relation can be estimated statistically, and that all materials must behave in a similar way. At these pressures the outer electronic shells of the atoms are crushed; the electrons continue to move in different orbits but can be treated as independent of each other. In this region the pressure increases with the 5/3-power of the density. However, the pressure in the interior of the earth only reaches a value of about 3×10^6 atmospheres at the center. Professor Fermi reported the results of a paper by Jensen (*Zeits. Physik*, 1938), who extended these calculations to somewhat lower pressures. Jensen's results are valid only down to about 10^7 atmospheres, but by interpolating between his results and the experimental data at 2 to 5×10^4 atmospheres, one finds agreement with the densities and compressibilities which geophysicists have deduced for the iron in the core of the earth. As one immediate result of these discussions, calculations along similar lines are now in progress for the intermediate pressure region (10^5 to 10^6 atmospheres).

Professor Fermi also estimated the melting-point of iron under a pressure of 3×10^6 atmospheres. He used

a formula based on the assumption that a solid melts if the amplitude of the thermal vibration of its atoms reaches a certain fraction of the interatomic distances. On this basis the melting-point of iron in the core of the earth is approximately 10,000° K, a value which is rather higher than previous estimates.

Dr. Gutenberg then discussed the evidence from seismology and earth-tides which indicates that the deep interior of the earth is in a fluid rather than a solid state. Dr. Kracek presented various considerations bearing on the composition and probable stratification of the interior, and various points in this connection were discussed by Drs. Gutenberg, Griggs, Herzfeld and Bardeen.

Related material of special interest was presented the following day by Dr. Goranson, who discussed new measurements of compressibility extending to a pressure above 200,000 atmospheres, made with a cascade-bomb equipment under development at the Geophysical Laboratory of the institution for the past year or more.

The main topic of the discussions on the second day was the origin and maintenance of the great magnetic field of the earth. Mr. McNish first gave a description of the magnetic moment, its representation by a minimum number of internal dipoles (fourteen dipoles at the surface of the core, 3,000 kilometers down, plus one eccentric dipole near the center), and discussed the secular variation. Dr. Vestine presented various data and calculations respecting the electrical conductivity of the earth at different depths, as inferred from the diurnal and magnetic-storm variations.

Dr. Elsasser then discussed various theories of the earth's magnetic field. In particular he presented his own recent ideas according to which the magnetic effects may be due to large thermoelectric currents maintained by mass-convection currents in the fluid core. The guiding of this convective flow by the Coriolis forces is used to explain the relation between the direction of the magnetic field and the earth's rotational axis. Questions of energy, viscosity, eddy-currents and differences in temperature and composition in various regions were taken up.

Calculations which throw some doubt on this theory were put forward by Drs. Inglis and Teller. The known heat-transport through the mantle limits the convection-currents and the Coriolis forces, so that the orientation and ordering of the currents remain unexplained. The discussions thus brought out new material on an obscure point; these calculations are now in press.

Dr. Gunn discussed the dynamo-theory in relation to the earth's interior, and the possibility of a ferromagnetic core was discussed by Professor Slater. The Curie point is probably lowered by increase of pressure, but a review of the properties of metals in the iron group shows that none of these is at all likely to be ferromagnetic at any temperature which is reasonable for the earth's core.

The remainder of the discussions on the second and third days was devoted to radioactivity in the earth and to problems of viscosity. Dr. Urry presented the results of examinations of numerous measurements on the radioactivity of meteorites. If these are fragments of a former planet, the implication is that the interior of the earth has perhaps a hundred times smaller concentration of radioactive material than the crustal rocks. However, even so small an amount of radioactivity distributed throughout the earth produces more heat than is conducted away through the surface. It seems possible on this basis that the core may be several hundred degrees hotter than it was when the mantle first solidified. Dr. Adams summarized recent discussions of rocks which are considered most likely to be similar to the deep-lying parts of the mantle, and which show practically no radioactivity. This may be the real answer to the familiar dilemma of a cooling earth which is overheating from within.

Professor Gutenberg pointed out that according to the analysis of earthquake waves the core of the earth (the region below a depth of 3,000 kilometers) is liquid.

From tidal deformations of the mantle, measured at the earth's surface, one can conclude that the core must have a much lower viscosity than the mantle. Indeed, the low absorption of longitudinal earthquake waves in the core indicates that the core has a viscosity smaller than 10^{10} CGS units, which is roughly the viscosity of ordinary pitch in cold weather. The viscosity throughout the mantle is about 10^{23} CGS units, while molten metals have viscosities smaller than one CGS unit.

Viscous liquids as a rule contain complex chain-like molecules, while all monatomic liquids have low viscosities. It is probable that high pressure does not give rise to a high viscosity for liquid iron. The pressure raises the melting-point, but when melting has taken place the viscosity of the metal should be quite low.

Dr. Griggs and Dr. Gutenberg also discussed general questions concerning the viscosity of solids. It seems that definitions and concepts regarding permanent and non-permanent deformations of solids are as yet not quite clear cut, partly because the behavior of matter in the solid form under continued stress is complicated.

This conference had as its objectives: (a) To formulate the problems and data of geophysics which may be of interest to workers in theoretical physics and (b) to put at the service of workers in geophysics a growing theoretical knowledge concerning the behavior of matter under unusual conditions, especially at very high pressures. Experts in a variety of fields can thus be of mutual assistance if their attention is focussed on certain problems of geophysics. That this meeting pro-

vided an immediate basis for further cooperative work has already been demonstrated, as extended calculations on several questions have already been undertaken by several theoretical physicists, and the Physics Seminar at one university will be devoted next year to geophysics.

Representatives from a total of twenty-four universities, research organizations and governmental bureaus took part in this conference. Among those attending the conference from outside of Washington were: Professors J. Bardeen, H. A. Bethe, F. Bitter, G. Breit, W. H. Bucher, W. M. Elsasser, E. Fermi, D. T. Griggs, B. Gutenberg, D. R. Inglis, I. I. Rabi, J. C. Slater and J. H. Van Vleck.

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SPECIAL ARTICLES

COENZYME I AND RIBOFLAVIN CONTENT OF LIVERS OF RATS FED BUTTER YELLOW

KINOSITA[1] and co-workers have shown that liver cancer can be produced in rats by the oral administration of dimethylaminoazobenzene (butter yellow). The chemical is fed (20 cc of 3 per cent. solution in olive oil to 1,000 grams of diet) in a diet of brown rice supplemented with carrot. Nakahara, Fujiwara and Mori[2] reported that beef liver added to the diet will prevent cancer production and Ando[3] published evidence that yeast also is protective.

We have investigated the *in vitro* respiratory rate as well as the Coenzyme I and riboflavin contents of the livers of rats fed various diets, as follows: (1) normal diet, (2) basal diet without butter yellow, (3) basal diet with butter yellow and (4) the same with 15 per cent. of dried brewers' yeast (No. 2040 Fleischmann Laboratories) added.

The Qo_2's were measured in a Warburg respirometer. The Coenzyme I content was measured by means of the fermentation technique of Myrback,[4] which was standardized in our laboratory by Dr. S. O. Dexter. The riboflavin was measured by a modification of the method of Hodson and Norris.[5]

We have found that the riboflavin and the Coenzyme I contents of the livers decrease markedly, whereas the Qo_2's of the liver slices do not change. Nakatani, Nakano and Ohara[6] also found no difference in the Qo_2's of the liver slices throughout similar experiments.

Table 1 shows the results obtained from the study of livers of animals which had been on their respective diets between 50 and 110 days.

TABLE 1

	Normal diet		Basal diet		Basal diet and butter yellow		Basal diet and butter yellow and whole yeast		Butter yellow tumor		
Qo_2	8.8	(8)	9.0	(14)	9.5	(12)	9.0	(8)	9.5	(8)	
Ribo-flavin	170	(8)	124	(12)	70	(17)	170	(8)	33	(8)	gammas per gm dry wt.
Co I	1390	(8)	1370	(12)	500	(21)	1400	(8)	150	(8)	gammas per gm wet wt.

NOTE: Numbers in parentheses refer to number of animals.

The Coenzyme I content of the kidneys of the same animals was not decreased in any group, a fact which serves as a check of the precision of the method:

CoI 1410 (8) 1400 (12) 1490 (16) 1380 (8) gammas per gram wet weight

The measurement of either flavin or Coenzyme I content of the liver serves as a useful index of the protective effect of dietary supplement.

Experiments are now in progress to determine whether or not the administration of nicotinic acid and riboflavin in large amounts will protect against the action of dimethylaminoazobenzene in the rat. Nakahara and coworkers have reported that the administration of 3 mg per rat per day of nicotinic acid and 20 gammas of riboflavin does not protect.[2b]

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BOVINE PSEUDORABIES OR "MAD ITCH" VIRUS

SINCE Shope[1] described "mad itch" in cattle in Iowa and subsequently[2] set forth the immunological relation of this disease to pseudorabies as described by Aujeszky[3] in Hungary, an occasional effort has been

1 Kinosita, *Trans. Jap. Path. Soc.*, 27: 665, 1937.
2 Nakahara, Fujiwara and Mori, (*a*) *Gann*, 33: 57, 1939; (*b*) *Gann*, 33: 406, 1939.
3 Ando, *Gann*, 32: 252, 1938.
4 K. Myrback, *Ergeb. Enzymforschung*, 2: 139, 1933.
5 Hodson and Norris, *Jour. Biol. Chem.*, 131: 621, 1939.
6 Nakatani, Nakano and Ohara, *Gann*, 32: 240, 1938.
1 R. E. Shope, *Jour. Exp. Med.*, 54: 233, 1931.
2 *Ibid.*, *Proc. Soc. Exp. Biol. and Med.*, 30: 308, 1932.