oxidations. Hemoglobin, then, is to be regarded as a specialized and occasional derivative of the universal heme. And in the study of biological oxidations we must now operate not with the vague idea of iron compounds, but more specifically and more profitably with the iron pyrrol complexes of the heme family.

The first proof[2] that heme identical with the heme of hemoglobin exists in tissues outside of hemoglobin, was an application of our work on the nature of hemochromogen[3, 4]. Every hemochromogen, as we had shown, is a compound of heme and some nitrogenous substance. The exact properties of a hemochromogen, in particular the exact positions of its sharp absorption bands, depend on what nitrogenous substance it contains. Furthermore, there is always the equilibrium

$$\text{Hemochromogen} \rightleftarrows \text{Heme} + \text{Nitrogenous substance}$$

If there is added to a hemochromogen containing the unknown nitrogenous substance X the known nitrogenous substance pyridine, which has a great affinity for heme, there results

$$X\ \text{Hemochromogen} + \text{Pyridine} \rightleftarrows \text{Pyridine hemochromogen} + X$$

By the addition of enough pyridine the reaction is driven to the right; X is displaced.

If pyridine is added to yeast, a two-banded pigment is obtained which is indistinguishable in respect to the position of its bands from the pyridine hemochromogen obtained by adding pyridine to crystalline hemin prepared from hemoglobin. We conclude that yeast contains heme and that any nitrogenous substance combined with the heme has been displaced by pyridine. Our conclusion has recently been confirmed by Fischer and Schwerdtel,[5] who have isolated hemin from the pyridine extract of yeast.

We were led to this experiment by the demonstration by Keilin[6] that cytochrome is present in a great variety of tissues and that the components of cytochrome have some of the properties of hemochromogens, although they are not identical with the hemochromogen prepared from hemoglobin. MacMunn[7] had likewise previously given evidence that substances related to hemochromogen are present in animal tissues.

Warburg and his fellow workers[8] have recently investigated the rôle of heme compounds in biological oxidations. Not only can heme catalyze oxidations *in vitro*, but the oxidations are stopped by the specific inhibitors of biological oxidations, such as cyanide. And combination of heme with nitrogenous substances influences greatly both the catalysis of the oxidations and their inhibition. For instance, heme combined with nicotine catalyzes the oxidation of cystein fifteen times faster than free heme.

Warburg discovered that carbon monoxide can stop the respiration of yeast in the dark, but not in the light. Based on this discovery and on Einstein's law of photochemical equivalence is Warburg's ingenious method of determining the spectrum of the substance in yeast with which the carbon monoxide combines. This spectrum proved to have the two characteristic bands of the carbon monoxide heme compounds.

Altogether, as a result of knowledge based on *in vitro* experiments with hemoglobin and the easily prepared heme derivatives, the existence of heme in aerobic tissues generally has been demonstrated, and the study of the catalysis of biological oxidations is now approached from the point of view of the iron pyrrol complexes. And because of the facts that the heme pigments have well-defined spectra and that their compounds with carbon monoxide are sensitive to light, biological oxidations can now be studied by new and powerful photochemical methods. In regard to hemoglobin itself, a new insight has been gained into its place in the economy of nature. Hemoglobin is a specialized derivative of the universal heme.

M. L. ANSON
THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, PRINCETON, N. J.

A. E. MIRSKY
THE HOSPITAL OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK CITY

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THE NATIONAL ACADEMY OF SCIENCES. III

The Cambrian in northern Maine: EDWARD S. C. SMITH. A thick series of folded slates and sandstones is found along the banks of the east branch of the Penobscot River in Township 5, Range 8, Penobscot

County, Maine, in which are found abundant remains of *Oldhamia occidens*. There is some doubt as to the exact nature of this organism, but it was probably some sort of calcareous alga. These are the first Cambrian fossils to be reported from the state of Maine, and their presence indicates a Cambrian sea way hitherto unreported.

Geology of the Capitol District: RUDOLF RUEDEMANN. The geological map of the Capitol District comprising the Schenectady, Cohoes, Albany and Troy Quadrangles has been finished this fall by the writer. The formations range from the Lower Cambrian to the Upper Devonian and were deposited in two parallel basins or troughs that are portions of the Levis and Chazy basins that in the north compose the Appalachian geosyncline. The investigation has brought out the astonishing fact that during Ordovician time two entirely different sets of formations were deposited in the basins and that the deposition took place alternatingly in the troughs, each basin having been four times submerged and raised again, in alternation with the other. A hypothesis to explain this remarkable phenomenon was offered. The Taconic revolution with its folding and overthrusts at the end of Ordovician time and the Appalachian revolution were briefly mentioned and the effect of the glacial period on the district noted.

Problems relating to the Grand Canyon: J. C. MERRIAM.

A census of the Pleistocene mammals of Rancho La-Brea, based on the collections of the Los Angeles Museum, by Chester Stock: J. C. MERRIAM.

Further studies on the influence of a power dam in modifying conditions affecting the migration of salmon: H. B. WARD (introduced by S. A. Forbes).

Sex control in a daphnid: ARTHUR M. BANTA and L. A. BROWN. It is well known that in most animals there is a sex-determining mechanism, the so-called sex-chromosomes, and that the sex to be developed from an egg depends upon whether a female- or a male-determining sperm has effected fertilization. Even in parthenogenetic organisms, in which the egg develops without fertilization, sex is known in some cases to conform with the distribution of the sex-chromosomes. But there are certain cases in which sex-determination does not readily seem to fall under the operation of such a mechanism. One of these apparent exceptions has been the daphnids. In these prevailingly parthenogenetic species, both females and males are produced from unfertilized eggs which have not had chromatic reduction. Mothers under normally favorable conditions produce only daughters. If mothers (*Moina macrocopa*) are crowded, are reared at low temperature (11° to 14° C.), or are otherwise (as by treatment with drugs) subjected to certain conditions which retard their development, their eggs instead of developing into exclusively female offspring, develop into young, all or a considerable percentage of which are males. It is clear then that sex in this animal is subject to control by environmental factors. Control measures to be effective must be exercised during a definite period —about four hours before the eggs are laid. After this critical period for sex-control the sex is fixed and is no longer subject to control measures. It is an interesting and probably significant fact that this critical period occurs apparently about three and a half hours before the beginning of the single maturation division of the egg; and it is at the maturation division that the sex-chromosome mechanism, if existent in these forms, should operate to determine the sex of the forthcoming young. Although no sex chromosomes have been discovered in this exceedingly difficult cytological material, it is probable that the sex-control which we have accomplished through environmental factors operates through *control of a sex-determining mechanism*. There are, to be sure, alternative possibilities, (1) that there is no sex-chromosome mechanism in these organisms, or (2) that environmental conditions override the sex-determining mechanism or (3) that there is some internal mechanism still more fundamental than the sex-chromosome mechanism. But the evidence suggests, and on the whole it seems safer to assume, that we are working through a sex-chromosome mechanism. Sex control is of much practical and sentimental interest. The case here discussed and other similar cases, as they are analyzed, serve to still further emphasize the probable universality of the sex-chromosome mechanism. Obviously if sex is to be controlled in higher animals the sex-chromosome mechanism must be taken into account. If it were possible to control the type of sperm, whether a female-determining or a male-determining sperm, which fertilizes an egg the sex of the resulting individual might thereby be controlled. Unless and until such control is accomplished, sex-control in higher animals seems beyond the possibility of attainment.

Late geologic deformation of the Appalachian Piedmont as determined by river gravels: MARIUS R. CAMPBELL. The high land in the Piedmont region of Maryland and Pennsylvania has long been a puzzle to geologists and geomorphologists and some advanced the idea that it is due to recent crustal deformation, but as no positive proof of this proposition was adduced, it has remained an unproved hypothesis, until the writer conceived the idea that it might be demonstrated by a study of the river gravels which are known to abound in this region.

These beds, known by the names of Bryn Mawr and Brandywine, are of late Tertiary age. They were first studied by the writer on Potomac River in and about the city of Washington, but the results, although indicating crustal movement, did not furnish positive proof that it had occurred. The writer then waited for an opportunity to test his method on streams farther north. This opportunity came during the past summer and the results seem so conclusive that he presents them here for the consideration and criticism of others.

The evidence secured on Susquehanna River is the most satisfactory and will be given first. On this

stream the Bryn Mawr, which is the older of the two gravel beds, is well shown in the vicinity of Havre de Grace, Md., at an elevation of 400 feet above sea level, and the Brandywine gravel at an elevation of 300 feet. Throughout the gorge of the river, or from Havre de Grace to Columbia, Pa., the Brandywine gravel, as determined at many places, is nearly horizontal, ranging from an elevation of 300 feet at the mouth of the river to 360 feet at Columbia; but the Bryn Mawr gravel forms a low broad arch, rising from an elevation of 400 feet at the mouth of the river to 660 feet at Safe Harbor, Pa., and thence descending to about 550 feet at Columbia. Above Columbia the Brandywine gravel is nearly level as far as Harrisburg, some 70 miles above Havre de Grace, and the Bryn Mawr gravel descends slightly until, in the vicinity of Middletown, Pa., it reaches an elevation of about 480 feet. This elevation is held for a few miles and then, near Harrisburg, the gravel begins to rise up the river in accordance with the known deformation of the Appalachian region.

The flatness of the Brandywine gravel and the decided arch of the Bryn Mawr gravel show conclusively that after the deposition of the latter and before the former was laid down, an uplift occurred which raised the Bryn Mawr gravel at Safe Harbor 260 feet above its position at Havre de Grace and at least 180 feet above its level at Middletown; and as both beds are of late Tertiary age, the uplift of the anticline must have occurred also in that epoch.

The Potomac and Schuylkill rivers yielded similar results, showing that the Bryn Mawr gravel has been uplifted, but the fold is lower and also narrower than it is on the Susquehanna River. When platted on a map the axis of this fold crosses Susquehanna River just above Safe Harbor, Potomac River above Great Falls, and probably crosses Schuylkill River near Norristown. It is best developed on the Susquehanna, and from this point it probably plunges in both directions, disappearing to the south as an anticlinal fold about 20 miles south of Fairfax, Va., and to the east about 8 or 10 miles east of Norristown, Pa.

The growth curve of the suckling mouse: E. CARLETON MACDOWELL. The many secondary variables that influence the processes of growth complicate the study of its innate limitations. The method of averages has been relied upon to eliminate the effect of these secondary variables, and much theorizing has been based on the assumption that average curves of populations represent the innate chemistry of growth. But averages do not unmask the innate processes, because the secondary variables are in the nature of limitations and so tend to act in one direction. The nature of the innate processes is concealed to the extent that any of these variables is working. Hence they must be eliminated in other ways than by averages. Since the prenatal growth of a mammal takes place under conditions more uniform than are found in any other period, the study of the growth of embryos offers the best opportunity to observe the type of curve determined by innate processes. Such a study based upon nearly 1,000 mouse embryos raised under carefully defined conditions yields a growth curve in the form of a continuous parabola of the form $W = Kt^n$ in which W is the weight at age t counted from the appearance of the anlagen of the embryo. In post-natal life the most uniform conditions can be secured during the nursing period—the first two weeks after birth. But the curves published for the suckling mouse are not parabolas; instead they show a rise in the absolute increments during the first week with a decline during the second week, thus forming what has been called the infantile growth cycle. This paper presents data showing that under normal conditions the limiting factor in the growth of the nursling mouse is the quantity of mother's milk. When this limitation is removed, the growth which produces a fourteen-gram mouse in fourteen days follows a continuous parabola throughout the whole period. The regularity and consistency of the individual curves may be taken to indicate that in these curves the limiting factor is the innate process of growth. Thus at least one of the typical mammalian growth cycles is not due to the nature of the growth processes but to an external variable—the quantity of food. At fifteen days an abrupt change in slope is immediately related to the shift to solid food. Growth, under the same conditions of life, proceeds in a continuous manner; coincident with a change in the conditions of life, as at birth and at weaning, the rate of growth changes, but the same mathematical law describes the progress of growth under the new conditions, and the innate processes are of the same nature.

The Antillean spider fauna—a study in geographic isolation: ALEXANDER PETRUNKEVITCH. Peculiarities in the methods of distribution of spiders make the study of geographically isolated faunas, such as the Antillean, not only interesting in itself but of value in its bearing upon general problems of evolution. The present paper is based on the study of new and extensive collections of spiders from Porto Rico, Jamaica, Guadeloupe and Dominica. While the study is still in progress, sufficient material is available to draw the following conclusions. There are two distinct Antillean faunas, that of the Greater Antilles and that of the Lesser Antilles. The former represents the eastern outgrowth of the Central American fauna presumably by way of an earlier land-connection. The fauna of the Lesser Antilles has South America and particularly Venezuela for its origin and developed along the path of the air-currents, especially of the hurricanes. In Porto Rico we find the last traces of this fauna, admixed to the fauna which came from the west. Species characteristic of certain islands and not found anywhere else, wherever chance importation is reasonably excluded, may be regarded as having originated on the respective islands and are therefore indicative of the evolutionary trend of such isolated faunas. There is no evidence of any kind to show either the influence of the trade winds on the Antillean fauna or even a distant relationship between the latter and the African fauna.