DR. ROBERT REDFIELD, professor of anthropology at the University of Chicago and dean of the Division of the Social Sciences, has leave of absence for six months beginning in September to make a study of social science problems in China. The trip is sponsored jointly by the Social Science Research Council and the University of Chicago. It will be financed by a grant of the Rockefeller Foundation.

DR. VINCENT DU VIGNEAUD, professor of biochemistry at Cornell University Medical College, will deliver on August 1, 3 and 8 the Hitchcock lectures of the University of California at Berkeley. The Hitchcock Foundation, which provides lecturers on "scientific and practical subjects but not for the advantage of any religious sect or upon political subjects" was established in 1872 by Charles M. Hitchcock. A bequest from his daughter, Mrs. Lillie Hitchcock Coit, increased the endowment to $125,000.

THE annual meetings of the Association of American Geographers and of the National Council of Geography Teachers, that were to have been held from September 10 to 13, have been cancelled.

THE demand for the Smithsonian War Background Studies has been so great that it is no longer possible to continue to print more copies for unrestricted free distribution. The entire cost of the series has been defrayed from the private funds of the institution, and money for a further free edition is not available. The editions of most of the papers have been practically exhausted, and in order that they may continue to be available to those who need them, it has been decided to print additional copies to be sold on a non-profit basis to individuals, other than members of the armed forces. These will be available in August. Hereafter the smaller papers, Nos. 2, 3, 5, 8, 12 and 17, will be sold for 10 cents a copy; all others for 25 cents a copy.

THE Nutrition Foundation has awarded grants to the Harvard Medical School, Boston, to support fellowships in clinical nutrition for the years 1944, 1945 and 1946. The fund will be administered under the supervision of Dr. Frederick J. Stare, assistant professor of biochemistry and nutrition. The fellowships provide for post-doctorate training in medicine and for advanced training in medical nutrition for dietitians.

THE Sealy and Smith Foundation has offered a million dollars to the University of Texas for a new general hospital unit at Galveston. The gift is contingent on an appropriation by the university of a second million dollars.

DISCUSSION

EXOTOXINS FROM SLIME MOLDS

LIVING cells exude waste products. This is a well-known physiological function which presents a variety of problems, one of which is the toxic effect of the waste products of one cell upon another. Several years ago I observed the reaction of a slime mold to the exotoxins given off by another slime mold. Publication was delayed in the hope that some information could be had on the organic nature of the exuded waste products. As this has until now proved impossible—it will at best be a difficult task—I have chosen to report briefly the original observation, namely, the reaction of slime molds to one another's exotoxins.

The organism worked upon is the myxomycete, *Physarum polycephalum,* now a familiar source of material for physiological work on protoplasm. The plasmodium, or slime mold is a multinucleate, noncellular body. The protoplasm of the slime mold Physarum is in a continual state of motion, except when dormant. Protoplasmic flow continues in one direction for three quarters of a minute and then reverses. The movement is, in its general appearance, much like the ebb and flow of the tides. Streaming in the outward direction averages five seconds more than in the return direction: this additional time accounts for the onward progress, the locomotion, of the organism.

Botanists have presumably long known that slime molds rarely recross their tracks. Possibly the cause of this was also suspected to be the toxic nature of the residue left behind by the advancing mold. No more than this is known of the physiology or the chemistry of the waste products given off by slime molds. The exuded exotoxins may be regarded as secretion products, the whole organism functioning as a kidney. After all, this is true of any living cell. There is an unfortunate tendency in biology and medicine to regard protoplasm in a simple form such as the slime molds represent, as devoid of all the properties of higher organisms, thus forgetting that the properties of the organism as a whole exist in large measure because they are properties of protoplasm. The heart pulsates because protoplasm pulsates. If organisms show irritable response, protoplasm must do likewise. Kidneys secrete because protoplasm secretes.

My casual interest in the exotoxins of slime molds

became an intensive one when, during a study of the fusion of slime molds, certain plasmodia failed to fuse.

Two individual masses of slime mold protoplasm approaching each other will, under favorable conditions, meet and fuse. After uniting, extraordinarily large and well-developed "arteries" of active flow are established at the point of transfusion. The excessive development of the connecting "artery" and the abnormally rapid flow of protoplasm through it are due to the release of pressure in the region of the union. With the sudden release of the surface tension which opposes the outward flow, there is an onrush of protoplasm which augments the rate of streaming and produces over-development of the channel of flow. This phenomenon was the subject of my study. But often, while waiting for fusion, I waited in vain. Two approaching plasmodia would occasionally halt at a short distance from each other, and there remain. A zone of definite width was established and maintained between them.

Another form of the reaction of slime molds against the exotoxins of others of their kind is seen in the direction of movement or locomotion of plasmodia when several are in close proximity to each other. If the time is sufficient to permit waste products to form and collect between the plasmodia, the direction of movement of all of them is away from the center of the group, away from the center of maximum toxicity.

The pertinent facts may be stated as follows. When two slime molds rapidly approach each other and meet head-on, fusion always occurs and is immediate, provided the two plasmodia are of the same species and grown under similar conditions. But if the approach is gradual and there is thus time for the waste products of each plasmodium to collect at the approaching surfaces, then no fusion takes place. In short, no plasmodium will enter the zone of toxic waste products surrounding another plasmodium.

The toxic strip which separates two plasmodia is about 0.15 mm wide. The band is often of extraordinarily constant width which is maintained even when the plasmodia have irregular contours; the two boundaries may fit one into the other very much like two corrugated surfaces in which the crests of one fit into the troughs of the other.

The affinity and antagonism of cells for each other is a problem of great importance, applicable to a variety of situations throughout the living world. The failure of some sperm to accomplish the fertilization of eggs of the same species is due to lack of chemical affinity and this may be a question of exotoxins. Incompatibility due to the presence of exotoxins may also be the cause of the failure of conjugation between protozoa of the same species. "Mating types" in Paramecia may be determined by the reactions of one type to the exotoxins of the other type. The ingestion, or taking in of food, of one unicellular organism by another must in part be determined by the toxicity of the cell which serves as food, and this may be a matter of the environment of waste matter which surrounds the cell ingested. The engulfing of living cells by other cells assumes a special function in phagocytosis. The ingestion of some bacteria and not of others by the scavenger cells of the blood may be a question of the toxic effect of one cell upon another. All these examples, like that of the failure of two slime molds to fuse, may be determined by cellular exotoxins, by the secreted waste products of cells.

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CHOLINESTERASES

MENDEL and Rudney, in SCIENCE of January 14, 1944, again claimed priority for our earlier[1] discovery of two distinctive types of cholinesterase in the body. Their contention is apparently that since we failed to note a certain similarity of behavior between cholinesterases from blood cells and from serum we could not have been aware of their differences, which were in fact strikingly apparent in our comparisons of the two types of preparations. Even if one accepts their empirical test as definitive, their own data show only 2 per cent. of the activity of human serum to be due to cell type enzyme.

In the same note they quoted de Laubenfels as asserting that we had " 'thoroughly demonstrated' the existence of the true and pseudo-cholinesterase." This is inaccurate. De Laubenfels[2] correctly stated that we had proved the existence of two esterases capable of hydrolyzing acetylcholine, without implying that we had proffered a conclusion regarding their relative degree of specificity. Indeed, if we had, our reported evidence would have led us to the opposite conclusion from that of Mendel and Rudney.

We wish to record our support of de Laubenfels'[2] contention that "pseudo-cholinesterase" is an unfortunate name for an enzyme that has been so long and extensively studied under the name cholinesterase. In addition, current studies of serum cholinesterase in relation to disease, as in myasthenia gravis, as well as the findings of Glick[3] on the behavior of the enzyme of the cat superior cervical ganglion, make the acceptance of "pseudo-cholinesterase" as a suitable name for the serum enzyme seem inadvisable.

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[1] G. A. Alles and R. C. Hawes, *Jour. Biol. Chem.*, 133: 375, 1940.

[2] M. W. de Laubenfels, SCIENCE, 98: 450, 1943.

[3] D. Glick, *Jour. Gen. Physiol.*, 21: 431, 1938.