lapsus calami? Probably not. How, then, can the change to the correct form be authorized?

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TROCHOSPONGILLA HORRIDA IN ARKANSAS

WE report the presence of *Trochospongilla horrida* Weltner in the East Fork of the White River near Elkins, Arkansas. The colonies collected were on the under side of stones in a shallow portion of the river where the water is scarcely flowing. The flat, branching colonies were a dirty white in color. Gemmules were present in specimens collected on July 23, 1936. The strongly spined skeletal spicules and the birotulate gemmule spicules with smooth entire margins make the identification certain.

Although reported in recent years from such far apart localities as Germany, Russia, Turkestan and China, *T. horrida* appears to have been found in the United States only four times: twice in Illinois,[1] once in Delaware[2] and the present collection in Arkansas. It appears to be the first fresh-water sponge to be reported from the state of Arkansas.

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WANTED: A NEW WORD

THE word should be from the Greek because a companion word is from that language, although the late Professor Burt G. Wilder said that a mule word might be as useful as a mule animal. He quoted appendicitis in this connection.

There is a large literature relating to planktonic food for many kinds of organic life. An equally large literature should belong to benthotic food, but the awkwardness of the expression is doubtless responsible for its hiding out of literature. According to the dictionary "benthos" relates to the bottom of the sea. This is not descriptive in application for the food of many forms of aquatic life living in shallow waters—for example, that of mollusks, fishes and even young ducks which feed upon the layer of living organic matter resting upon the top layer of mud in shallow water. Among the fishes we know that hypoglossidae, catostomidae and siluridae may thrive upon this top layer of mud without depending upon larger organic prey. We all know the roundish marks on the top layer of mud made by the fishes commonly known as suckers. I could not account for long scoops made on the top layer of mud until one cloudy afternoon standing upon the railroad track near Union Springs, New York, I watched a number of bullheads feeding. They would stick the tip of the lower jaw a little way into the mud and then with a few quick movements of the caudal fin they would force themselves ahead, making the mysterious scoop markings on the mud.

At the foot of our lawn in Stamford young wild ducks know enough to feed upon the top layer of mud without being taught by parents until they are large enough to eat Nuttall's pondweed and the cracked corn which we give them.

Flounder fishermen of the Great South Bay say that mud is the only food in the stomachs of millions of flounders after they are thin from February spawning. It would be difficult for these millions of flounders to find other food. That takes me to the question if the "sideswiping" mouth of flounders is not a matter of adaptation of a species to food conditions in the course of descent.

Many years ago as a boy at New Haven I took home a fish basket of young bullheads still alive that my father said were not worth the bother of skinning. I took them to the numerous small pond holes in Beaver Meadows west of New Haven and forgot them until the meadows were filled in, when local residents collected basketfuls of well-fed bullheads as the filling in crowded them out. There was little beside the top layer of mud for them as food supply. Now I want a word for this food supply. I have asked my friends who are Greek and Latin scholars, but they have failed me after my own limitations had been reached.

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SPECIAL ARTICLES

THE ULTRACENTRIFUGAL CONCENTRATION OF PNEUMOCOCCIC ANTIBODIES

THE ultracentrifugal analysis[1] of concentrates of the Type I pneumococcic antibodies from horse serum has shown that their proteins consist mainly of molecules with a sedimentation constant of about 16×10^{-13} cm. sec^{-1} $dynes^{-1}$. This, together with the presence of such molecules in the untreated antipneumococcic horse serum and their complete or almost complete absence from normal serum, is evidence that they are the real bearers of the antibody activity. Further support for this view is supplied by the observation[2] that after ultracentrifugation, most of the antibody activity appears at the bottom of the cell. The fol-

[1] Frank Smith, *Bull. Ill. St. Nat. Hist. Surv.*, 14: 11: 9–22, 1921.

[2] M. C. Old, *Trans. Amer. Micr. Soc.*, 51: 4: 239–242, 1932.

[1] J. Biscoe, F. Herčík and R. W. G. Wyckoff, SCIENCE, 83: 602, 1936; M. Heidelberger, K. O. Pedersen and A. Tiselius, *Nature*, 138: 165, 1936.

[2] M. Heidelberger, K. O. Pedersen and A. Tiselius, *op. cit.*

lowing experiments in which considerable quantities of serum and commercial antibody preparations were centrifuged in a vacuum centrifuge turning at 25,000 r.p.m. point to the same conclusion.

In these experiments two kinds of commercial Felton antibodies and an untreated antipneumococcic horse serum were centrifuged for several hours in a maximum field of ca 40,000 gravity. After stopping, the top and bottom fractions were withdrawn and subjected to the following measurements: (1) a titration of antibody content; (2) a determination of refractive index as an indication of protein content; and (3) an ultracentrifugal identification of the protein molecular species they contain. The titrations, following the method of Zozaya, Boyer and Clark,[3] were all made with the same Type I polysaccharide solution; the ultracentrifuge was of the air-turbine type recently described.[4]

Felton antibodies are now manufactured by at least two different procedures. One of these preparations (A) is made by precipitating antipneumococcic horse serum with water and dissolving in salt solution the precipitate carrying the desired activity. The other mode of manufacture (B) is more complicated, involving precipitation of the original serum with alcohol and subsequent separations at different pH's. These two concentrates did not look alike after centrifuging. Preparation (A) consisted of two layers with a sharply defined boundary. The upper two fifths (A top) was water clear and of low viscosity; the rest was a light amber-colored fluid, which became more viscous and more highly colored towards the bottom of the cell. The bottom third of this layer (A bottom) was used for analysis. Preparation (B), which was initially a stronger solution than (A), also showed two layers after centrifuging. In keeping with its higher viscosity the clear top layer (B top) had only a small relative volume (ca 5 per cent. of the whole) and the bottom-most part of the lower layer had almost the consistency of a gum. The bottom fifth of the lower layer (B bottom) served for analysis. No fraction of (B) showed any color. The bottom layers (A bottom) and (B bottom) were recentrifuged; their lower layers are designated (A bottom, 2) and (B bottom, 2). When untreated antipneumococcic horse serum (H) was centrifuged, it developed three layers: (1) a top layer (volume = ca 10 per cent.) which contained the suspended matter present in the original serum and was without antibody activity; (2) a colorless moderately viscous intermediate layer which was largely albumin (volume = ca 15 per cent.) and (3) a layer which became progressively more colored and more viscous as the bottom was approached. The bottom portion (H bottom) was a clear amber fluid.

The results obtained from these various fractions are collected in Table I. It is obvious that in solutions

TABLE I

THE APPROXIMATE CONCENTRATIONS AND DILUTIONS FOR PRECIPITIN END POINT FOR PNEUMOCOCCIC ANTIBODY CONCENTRATES

Sample	a gm/100 cc. solution	b Dilution	k = a/b
A	7.2	120	0.060
A (I+II)	8.2	120	.068
A bottom	13.4	160	.084
A bottom, 2	18.2	200	.091
B	12.8	180	.071
B (I+II)	13.4	200	.067
B bottom	17.2	240	.072
B bottom, 2	20.7	320	.065
H bottom, 2	16.4	200	.082
H	6.4	30	.213
A top	1.0	2	.500
B top	2.0	4	.500

consisting of only a pure protein antibody, the ratio of protein concentration (a) to the amount of dilution (b) needed to give a precipitin end point must be a constant (k). This is true for those fractions, especially of concentrates (B), that show only the protein with $s = 16 \times 10^{-13}$; all other fractions depart widely from constancy (column 4).

It is to be noted that the centrifugal force used was sufficient to yield an unaltered horse serum fraction with a protein content and antibody activity comparable with the commercial concentrates. The details of the ultracentrifugal analysis of these serum fractions will be published later.

Ultracentrifugal analyses of the two Felton concentrates gave results that were essentially the same. The only protein molecules to be found in the bottom layers were those with $s = 16 \times 10^{-13}$. The top fractions did not retain appreciable quantities of these molecules. Small amounts of their light molecules, which in each concentrate accounted for roughly 15 per cent. of the total protein content, were those of the principal serum globulin with $s = 7 \times 10^{-13}$; the rest, too light to sediment in a field 180,000 times gravity, were undoubtedly split products introduced by the procedures used in concentrating.

These experiments strongly support the idea that the Type I antibody is associated with the molecule having $s = 16 \times 10^{-13}$. The concentrates of antibodies against other types have molecules of the same size.[5] Since this is a molecular species that appears in appreciable quantities in horse serum only when it has become antipneumococcic, two possibilities suggest themselves. It is conceivable that during immuniza-

[3] J. Zozaya, J. Boyer and J. Clark, *Jour. Exp. Med.*, 52: 471, 1930.

[4] J. Biscoe, E. G. Pickels and R. W. G. Wyckoff, *Jour. Exp. Med.*, 64: 39, 1936.

[5] J. Biscoe, F. Herčík and R. W. G. Wyckoff, *op. cit.*

tion this globulin is made or freed in excess in order that there may be plenty of it present to fix all the antibody activity that may develop. This could be answered by investigating the parallel development of antibodies and s(16) globulins in horses undergoing immunization; against it is the fact that the antibody concentrates here studied, coming from very different sources, have the same protein antibody ratio, *i.e.*, k of Table I is practically the same. If the alternative, that the globulin is the antibody, is true, then it is of interest to find that in a bivalent concentrate containing equal quantities of Types I and II antibodies (A, I+II and B, I+II) the protein content is not increased by the presence of the additional Type II antibodies: this indicates that a single globulin molecule can exhibit the characteristics of more than one antibody.

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EARTH WORMS AS TEST OBJECTS FOR DETERMINING THE VALUE OF DRUGS TO BE USED IN HUMAN INTESTINAL HELMINTH INFESTATIONS[1]

THE earthworm has for many years enjoyed the reputation of being the test object *par excellence* for determining the efficacy of "anthelmintics." In attempting to foretell the effect of any drug in man, it is necessary to make tests on lower animals with the hope of avoiding unpleasant complications. Every experimenter is, however, aware of the fact that toxicity or lethality experiments carried out in such animals can not be transferred to man with the assurance that identical effects will be produced in this species. It would seem, however, that our present state of knowledge is such as to require that we use some judgment in the choice of biological test objects. An animal without a heart would not appear to be the best object on which to study cardiac drugs, or *Macrocanthorhynchus hirudinaceus,* which has no alimentary canal, for the investigation of cathartics.

It is doubtful, however, if a more diversified group of animals was ever brought together under one heading than those designated as "worms." This is well illustrated in J. Arthur Thomson's[2] description of these animals: "It is hopeless at present to arrange with any definiteness those heterogeneous forms to which the title 'worm' is given. For this title is little more than a name for a *shape,* assumed by animals of varied nature who began to move head foremost and to acquire sides. There is no class of 'worms,' but an assemblage—a mob—not yet reduced to order."[3]

It is bad enough when we assume that an anthelmintic should act equally well on unattached roundworms, tapeworms and blood-sucking hookworms, but it would seem as if the time had come when we should give up the indiscriminate use of a biological test object of any nature as long as it looks like a worm. However, leeches, vinegar eels and above all earthworms are used by many investigators in testing "anthelmintics," but those who have chosen for this purpose test objects with other shapes, as fishes and frogs, have been ridiculed. But would not a frog, whose feet admittedly differ in shape from those of an earthworm or even a butterfly serve as well as an earthworm for determining the ascaricidal value of a group of chemical substances?

The human Ascaris is a parasitic animal living in the gut of man. It has no respiratory or circulatory system in any way related to that of an earthworm. It can live under anaerobic conditions. It is covered with a chitinous coat which is very sensitive to certain substances that have been shown to effectively kill the animal by acting on or through it. The earthworm is a free-living species inhabiting not man, but the ground. It feeds on substances in the soil rather than those of the human gut. It has no chitinous coat. It is dependent upon a circulatory system with not merely a single heart but five pairs of these organs through which circulates blood containing both corpuscles and hemoglobin. Except for its shape, there is nothing which under any consideration could be used as an excuse for taking such an animal as a test object for ascaricides, especially when one can obtain with great ease pig Ascaris, which are morphologically indistinguishable from the human Ascaris.

In spite of this, a publication has just appeared on "Rational Use of the Earthworm for the Evaluation of Vermicides."[4] No explanation is given as to why this is considered a rational use of these animals, unless it is the four pages of mathematical calculations used in comparing the "rate of change of 'apparent' speed of fatality with change in molar concentration" of three substances.

During the past year we published an article on "Methods of Testing the Anthelmintic Properties of Ascaricides."[5] Our conclusions were based on experi-

[1] The funds for carrying out this work were given by the International Health Division of the Rockefeller Foundation.

[2] J. Arthur Thomson, "Outlines of Zoology," page 10.

[3] This opinion regarding the group of "worms," the "Vermes" of Linnaeus, is not confined to recent writers alone, and some of the most modern authorities consider the grouping made by Aristotle some two thousand years ago to be superior. They speak of the so-called "phylum Vermes" as a "wastebasket," a "Rumpelkämmer" or "attic," corresponding to that place where everything that had been respected for a hundred years was piled together to save it for future use which never came.

[4] G. L. Jenkins and L. L. Manchey, *Jour. Am. Phil. Asn.,* 25: 194–201, March, 1936.

[5] P. D. Lamson and H. W. Brown, *Am. Jour. Hyg.,* 23: 85–103, January, 1936.