partment of physics of Harvard University, who discussed "Atomic Nuclei and Radio-activity." Professor K. T. Bainbridge, also of the department of physics, spoke on "The Cyclotron and Induced Radio-activity." The concluding address, "Medicine and Induced Radio-activity," was given by Dr. Shields Warren, pathologist of the New England Deaconess Hospital, Boston. Later, the audience adjourned to the Gordon McKay Laboratory of Engineering, where the recently completed cyclotron was demonstrated in action.

THE seventh annual meeting of the Pennsylvania Junior Academy of Science was held recently at Washington and Jefferson College, Washington, Pa., with nearly two hundred and fifty boys and girls in attendance. Twenty-seven member clubs from every part of the state were represented. Caroline Emerson, Science Club of Lawrence Park High School, Erie, who spoke on "Harmful Patent Medicines," and Richard Jones, Science Club of the Johnstown Central High School, who demonstrated his Geiger-Mueller cosmic ray counter, were nominated to receive the honorary junior membership award for 1940 of the American Association for the Advancement of Science. Dr. Karl F. Oerlein, of the State Teachers College, at California, Pa., is the general chairman of the Junior Academy in Pennsylvania.

THE American Medical Association has entrusted the Committee on Therapeutic Research of the Council on Pharmacy and Chemistry with a modest fund to be expended in the promotion of investigations that may have therapeutic interest. The committee invites applications for grants in this general field, which should be in the hands of the secretary of the council, Dr. Paul Nicholas Leech, 535 North Dearborn Street, Chicago, Ill., by May 1, and which are limited to the purchase of materials or special apparatus.

THE Illinois State Academy of Science announces that it is still entertaining applications for research grants, and that awards will be announced at the annual meeting of the academy on May 3. Applicants should file their applications immediately with C. H. Behre, Jr., chairman of the Research Committee, care of the department of geology, Northwestern University, Evanston, Ill. Preference will be given to small grants intended for purchase of permanent equipment or material, and to applicants working in smaller institutions, in the State of Illinois, not liberally provided with research funds.

THE New York Academy of Sciences announces three prizes offered by A. Cressy Morrison, to be known as the A. Cressy Morrison Prizes I, II and III, which will be awarded in December, 1940. Prize I, of $500, will be awarded for the best paper on solar and stellar energy. Prizes II and III will be awarded for the best papers on a scientific subject included within the field of the academy and its affiliated societies. The competition for Prize I is open to all. Prizes II and III each of the value of $200 are limited to members, but non-members may become eligible by joining one of these organizations before the closing date.

SIXTY-SIX Canadian university students will take training in research in Canadian institutions under the National Research Council Scholarships during 1940–41. While the majority of these students will be engaged in chemical and physical investigations, such biological studies as genetics, plant pathology, physiology and zoology will each have a quota of students. Two special scholarships of $1,000 each will be held in the Division of Chemistry of the National Research Council Laboratories at Ottawa, by R. L. Cunningham and R. B. Harvey, of McGill University. Four fellowships of the value of $750 each, and thirty-seven studentships of the value of $650 each will be held at various universities directly under the auspices of the council. With the coopeoration of Canadian universities, the council is also awarding twenty-three bursaries of $250 each. The bursaries are available to students of high attainments who have just graduated and are ready to take their preliminary training in research.

DISCUSSION

THE QUESTION OF THE CELL THEORY

IN the article "The Case Against the Cell Theory"[1] which appeared in the March 15 issue of SCIENCE, the ciliate *Diplodinium* was cited as an organism that has developed systems which perform the vital functions without the "intervention" of cells. This is presented as evidence against the cell theory, yet the ciliates were stated to be monocellular organisms. If the claim had been made, as Dobell[2] and others have, that ciliates are non-cellular, there would have been clearer evidence, perhaps, to support the statement. But the simple fact that ciliates are provided with organelles that perform certain vital functions seems to be no better evidence against the cell theory than is the fact that tracheal epithelium is provided with cilia, muscle cells with myofibrils or nerve cells with axons and dendrites.

While the protozoon is a complete organism and may be compared to a higher animal as a functional being, its structure is admittedly that of a cell and

[1] B. J. Luyet, SCIENCE, 91: 252, 1940.
[2] C. Dobell, *Arch. f. Protistenk.*, 23: 269, 1911.

therefore its various parts are cell-parts or organelles, and are homologues of the parts of the tissue cell, and not of the organs of a metozoon. It is true that the ciliate is an elaborate cell, but its specializations are intra-cellular and as such can not be homologized with entire organs or systems of the Metazoa. The tubular "rectum" of *Diplodinium* is not a homologue of the rectum of higher animals and therefore the word "rectum" should not be applied to the ciliate organelle if it is to bring about confusion of relationships. The ciliates swim by means of cilia, but we do not compare them structurally with the fins of fish.

The "nervous system" of the ciliate with "brain" and fibers was also compared to that of the higher animals to show that cellular organization is not necessary. Ehrenberg had a similar idea, but Dujardin and others finally exploded it. Now, in the first place, the "brains" of *Diplodinium* and *Euplotes,* the two classical examples of the neuromotorium in ciliates, have both been shown to be artifacts.[3,4] Neurofibrils which coordinate ciliary activity are, however, present as clearly demonstrable organelles. But these fibrils are also present as true homologues in the ciliated epithelium of Metazoa. Does that make ciliated epithelium any less cellular in organization? Cell specialization itself is in no way opposed to the cell theory.

The article further points out that chloroplastids metabolize, grow, and multiply, and therefore should be considered living units. In a sense they are living units and the same could be said for mitochondria, centrosomes and the nucleus itself. One could also say that the units in a brick wall are not the bricks, but the sand particles in the bricks. In none of these cases, however, are they the units of structure of the complete organism because no possible combination of them alone will form the whole. Just because the cell theory does not mention specifically all these cellular constituents should we discard it? Because these cell-parts have specific functions are the cells no longer units? Has the geneticist abandoned Mendel's principles just because new complications have been discovered which the original proposition did not fully explain?

Lastly, if we are to distinguish cellular organization on the basis of cell partitions, we must thereby admit that the syncytia of higher animal tissues are non-cellular as well as the plasmodium stage of Mycetozoa, etc. At the same time we must call *Amoeba proteus* cellular. Then is a binucleate amoeba cellular or non-cellular? And does a neutrophil in human blood transform itself from a cell into a non-cellular protoplast when one of the delicate strands connecting the polymorphous nucleus breaks? Where shall we draw the line? And will not the line be arbitrary and rather unimportant?

The "Case Against the Cell Theory" is an interesting study and has some obvious points, but are we not attacking straw men in the form of strict definitions of the cell, when we rise to demolish a theory that is thoroughly sound if a few very minor interpretations or revisions are made? We shall certainly have to make many apologies to Mr. Schleiden and Mr. Schwann if we write another theory that explains the amazing similarity throughout living organisms of their cellular (sub- or super-cellular) organization.

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[3] C. W. Rees, SCIENCE, 71: 369, 1930.
[4] J. P. Turner, *Biol. Bull.*, 64: 53, 1933.

"ELECTRICITY ELICITED BY AN ORGANIC CHEMICAL PROCESS"

UNDER this title Berzelius, in 1817, described the discharge of electric organs. He based his assumption on the fact that the organs have no resting current and that the discharge here is a voluntary process, in contrast to the ordinary electric pile.[1]

Electric organs have been compared with an accumulation of muscle end plates. When, at these end plates a concentration of choline esterase was found, as high as necessary to admit that acetylcholine might be involved in transmission of motor nerve impulses[2] a similar mechanism was envisaged for the action of the nerves supplying the electric organ. A concentration of choline esterase of the same order of magnitude as calculated for motor end plates was found in the electric organ of Torpedo.[3,5] 1 g organ splits 1.5–3.0 g acetylcholine in 60 minutes.

In contrast to this high concentration of the enzyme, that found in the electric organ of *Raja* which has a weak electromotive force is low: 1 g organ splits only 0.03–0.1 g acetylcholine in 60 minutes. 1 g of the powerful electric organ of Gymnotus splits 0.9–1.5 g acetylcholine.

If the electromotive force of these organs per cm of tissue (in the direction of the current) and the number

TABLE I

	Volt per cm	Plates per cm	Q.Ch.E.*
Raja	0.5	15	3–10
Gymnotus	5–10	60–80	90–150
Torpedo	8–15	100–200	150–300

* Q.Ch.E. = mg acetylcholine hydrolysed by 100 mg tissue in 60 minutes.

[1] J. J. Berzelius, *Laerbook i Kemien.*, 1: 126, 1817.
[2] A. Marnay and D. Nachmansohn, *C. R. Soc. Biol.*, 124: 942, 1937.
[3] A. Marnay, *C. R. Soc. Biol.*, 126: 537, Paris, 1937.
[4] D. Nachmansohn and E. Lederer, *C. R. Soc. Biol.*, 130: 321, 1939.
[5] D. Nachmansohn and E. Lederer, *Bull. Soc. Chim. Biol.*, 21: 797, 1939.