by Dr. H. B. Haag, professor of pharmacology of the Medical College of Virginia, and Dr. M. G. Mulinos, of the College of Physicians and Surgeons, Columbia University.

THE National Council of Teachers of Mathematics will hold on December 29 and 30 its fifth annual meeting at Williamsburg, Va. The general subject of the meeting will be "Mathematics that Functions." There will be a joint dinner with the Mathematical Association of America and the American Mathematical Society on December 29. The council will meet in three sections as follows: Arithmetic Section, Secondary Mathematics Section and Teacher Training Section.

THE Medical College of Virginia, Richmond, celebrated Founders' Day marking the one hundred first anniversary of its founding on Thursday, December 1. Virginius Dabney, editor of the *Richmond Times-Dispatch,* spoke on "Medicine in a Changing World." The exercises were preceded by an academic procession of visitors, faculty and members of the student body.

AN aerial survey of an hour's duration of the geology of the New York region, sponsored by the Geological Society of America, is planned for Saturday morning, December 31, at the semi-centennial meeting of the society, which will be held in New York City from December 28 to 30. The trip will be led by Dr. Girard Wheeler. The group will start from the Newark airport and fly up the Hudson River past the Palisades, then northward to see the escarpment at the edge of the highlands. The plane will then swing southeast over Long Island Sound, where there have been changes resulting from the recent hurricane. After viewing the Long Island shoreline the return will be made to the Newark airport by way of Staten Island.

WESTERN RESERVE UNIVERSITY has received as a legacy from the late Mary Frances Morris, who died on August 2, a business building at 500 Prospect Avenue, in Cleveland. The yearly income, amounting to $2,000, is to be used for scholarships for young women in Flora Stone Mather College.

THE MEYERSTEIN INSTITUTE OF RADIOTHERAPY at the Middlesex Hospital, for the treatment of cancer by radium and x-rays, was recently opened by Sir William Bragg, president of the Royal Society. Its erection was made possible by a gift of $230,000 from Sir Edward Meyerstein. All forms of radiotherapy are available both for the in-patients and out-patients of the hospital and for private patients.

AS has already been reported in SCIENCE, David Cleghorn Thomson, formerly secretary to the Oxford University Appeal Committee, has been appointed general secretary, in succession to Mr. Walter Adams, of the Society for the Protection of Science and Learning (formerly known as the Academic Assistance Council) which for five years has been handling the academic side of the international refugee problem. *Nature* states that Cleghorn Thomson is a graduate of the Universities of Edinburgh and Oxford; a senior history exhibitioner of Balliol, he was for seven years the B.B.C.'s chief official in Scotland. The Society for the Protection of Science and Learning, of which the Archbishop of York recently became president in succession to the late Lord Rutherford, acts as a central bureau of information regarding professors, lecturers and research workers displaced in their own country on account of "race," religious or political opinions, and aids in securing the continuation of their valuable work in other countries. So far, of the 1,350 displaced scholars registered with this society, 520 have been permanently placed in thirty-eight countries, apart from more than 300 who have temporarily found work. Within the last three months, the society has received 340 applications from scholars who have had to discontinue academic activity in Austria. The offices of the society are at 6 Gordon Square, London, W.C.1.

THE senate of the University of London invites applications for the university chair of medicine, tenable at University College Hospital Medical School, with a salary of £2,000 a year. Applications (twelve copies) must be received not later than January 16 by the Academic Registrar, University of London, Senate House, W.C.1, from whom further particulars can be obtained.

# DISCUSSION

## PHOTOSYNTHESIS AND THE LIVING STATE

IT is hardly necessary to remark that no new definition of "The Living State" is contemplated. For the purposes of these remarks we may assume that the living state is associated with the heterogeneous but organized substance called protoplasm, and that such criteria as growth, reproduction, respiration and photosynthesis will be sufficient identification.

Hans Molisch[1] was perhaps the first investigator to announce that the evolution of oxygen from green plant cells was possible when the organism was no longer alive. He also attributed this important reac-

[1] H. Molisch, *Zeits. Bot.,* 17: 577, 1925.

tion to an enzyme. The data which led him to these conclusions were the fact that he could dry leaves for a few days at temperatures not above 30 degrees Centigrade and they would still evolve oxygen when moistened and illuminated.

In repeating Molisch's work it was found that the results could be confirmed readily with some plants but not with others. It was also found that if the plant leaves were ground with the proper buffers and then dried there was loss of the power to evolve oxygen. Luminous bacteria were used by both Molisch and the author to test for the release of free oxygen.

In undertaking further experiments along this line several methods of inhibiting the evolution of oxygen by irradiated organisms containing chlorophyll have been tried.

*Nitella* sp. cells were cut and the contents squeezed out and immediately tested for the evolution of oxygen. The results indicate that a positive test can be found if there is only a few minutes' delay between the time the cell contents are extruded and the test for the evolution of oxygen. The cell contents of *Valonia macrophysa*,[2] mixed with luminous bacteria, remained capable of evolving oxygen for two hours after cell disorganization. These cells were about one centimeter in diameter and even the evolution of oxygen from a single cell could be easily detected.

Press juice obtained by placing lawn clover (*Trifolium repens*) under high pressure evolved oxygen readily. Microscopic examination showed that no cells were present.

The reactions of *Euglena viridis* to low temperatures were the basis for the most of the present work. The *Euglena* cultures were grown in diffuse or artificial light at room temperatures.

When *Euglena* is kept at −4 degrees Centigrade for four hours and then brought back to room temperature (about 20 degrees Centigrade) the microscopic appearance indicates some plasmolysis and a tendency for the cells to become spherical. The evolution of oxygen is very weak and sometimes negative, apparently depending on the state of the culture used. At −40 degrees Centigrade for 20 minutes, with about one hour at room temperature to recover, there is generally evolution of oxygen when tests are made immediately. In fact, some cultures were frozen eight hours at −40 degrees Centigrade and tests for the evolution of oxygen made at once were positive. In all cases where freezing was at −40 degrees Centigrade for six hours the evolution of oxygen was only a temporary matter and the cultures would no longer grow in nutrient media. Tests for the absorption of carbon dioxide in a closed tube using phenolsulfonephthalein as an indicator were negative after four hours' freezing at −4 degrees Centigrade or one hour at −40 degrees Centigrade. Many experiments demonstrated that when both the absorption of carbon dioxide and the evolution of oxygen were negative the cultures would no longer grow. In many cases there was evidence that no carbon dioxide absorption was taking place in light, even though there was a temporary evolution of oxygen by the culture.

*Euglena, Spirogyra* and moss leaves showed much variability to freezing, and subsequent tests for the evolution of oxygen seemed to show that in some organisms there was a storage of some substance which would evolve oxygen for a short period of time, even though cells were absent or were so injured that they did not recover. One is reminded of the storage of luciferin-luciferase by *Cypridina* so that the protein enzyme complex can be extracted and perform its reaction of evolving light *in vitro*, but the inability to do the same with luminous bacteria. The explanation usually given for this observation is that the luminous bacteria do not store the luciferin-luciferase system, while *Cypridina* does.

These experiments tend to support the assumption that the evolution of oxygen is an enzyme reaction depending on radiation and not necessarily on the living cell except for the formation of the substance. This is further confirmed by the fact that hundreds of tests made on cell contents have shown that once the power to evolve oxygen is depleted in cell-free material, there is never any recovery. This would probably mean that there is a good chance that the complex responsible for the evolution of oxygen upon irradiation may be isolated, but it does not help much in looking forward to the understanding of how the living cell builds the oxygen-evolving substance.

It seems clear that we may conclude that the cells of some green plants may be disorganized and killed and yet retain for a short time some of their power to evolve oxygen upon irradiation. It is, however, very doubtful whether the absorption of carbon dioxide takes place so that a regular photosynthetic cycle is set up in such triturates. This points to the fact that there is, after all, a close relationship existing between the whole mechanism of photosynthesis and the organized living green plant cell.

O. L. INMAN

C. F. KETTERING FOUNDATION FOR THE STUDY OF CHLOROPHYLL AND PHOTOSYNTHESIS, ANTIOCH COLLEGE

[2] These *Valonia* cells were supplied by Dr. W. J. V. Osterhout, of the Rockefeller Institute, New York City.

## A SULFOXIDE OF METHIONINE

OWING to the biological interest attached to the sulfur-containing amino acid methionine any of its oxidation products are of potential significance. When a solution of dl-methionine perchlorate in isopropyl alcohol is allowed to react with an excess of hydrogen peroxide the amount of oxygen consumed upon com-