the earth's surface, kept going through the running down of energy and its escape from the earth," and they remark further that this view of the significance of the metamorphic cycle involves a slight modification of the prevalent interpretation of Hutton's law of uniformitarianism in that while the same series of processes are operating to-day as in the past they are now working on different propositions and distributions of substances than formerly, with consequently slightly different results.

A fourth part of the book is devoted to suggestions as to laboratory work in metamorphism, which by reason of its very general character appears to have been prepared as suggestions for instructors of laboratory students rather than for the students themselves. The book is a valuable contribution to the broad geological problems connected with changes of all kinds which take place in rocks, but its title is somewhat misleading.

J. P. Iddings

SPECIAL ARTICLES

A PLANT MEMBRANE FOR DEMONSTRATING OSMOSIS

The writer has noted with interest that the authors of recently published text-books in botany are still advocating the use of egg membranes and parchment membranes for the demonstration of osmosis. It is unfortunate that botany teachers should limit themselves to animal membranes, parchment membranes, or celloidin membranes in demonstrating to students this very important phenomenon in plant physiology. This is especially true when we have readily available a natural plant membrane which serves the purpose admirably. I refer to the testa of the lima bean.

Osterhout[1] has suggested the use of the testa of the lima bean in some osmosis experiments of rather limited visual value. In the botanical laboratories of Kansas University Professor W. C. Stevens[2] has used this membrane in the type of osmosis demonstration providing for a rise of the more rapidly diffusing liquid in a glass tube of narrow diameter. In our own classes we have found the experiment so satisfactory that the method is here presented in detail.

Two days before the experiment is to be set up, place a number of clean lima beans on clean moist paper or absorbent cotton in a glass jar and cover with a glass plate. As germination progresses some of the seed coats will split almost as soon as swelling begins. Others will stretch greatly without splitting. The latter will best serve for the experiment. It is also important to discard any which show signs of bacterial or mold activity. After selecting the bean to be used carefully split the testes through the micropyle and hilium and remove the two halves. Each will serve as an osmotic membrane. Soak the membranes in water for a few minutes to remove any wrinkles. With ordinary narrow rubber bands fasten the membranes tightly over the smooth ends of two clean glass tubes with inside diameters of 4–7 mm. Sugar or salt solutions may now be run into the tubes from the open ends, using a wire or fine glass rod to direct the flow. The tubes should be filled to a height of two or more inches and the level marked with accuracy. Be careful to avoid bubbles. The tubes may now be supported vertically by ring stands with the bean testa in contact with water in a glass dish. The height of the liquid in the tube will rise almost immediately and will continue to do so for several days. The usual variations of such experiments as to the liquids used may be satisfactorily employed with this membrane.

The writer has found this experiment the most simple of the osmosis demonstrations to set up. Five minutes is adequate with the apparatus at hand. With ordinary care the results are satisfactory in nine cases out of ten. The students appreciate a real plant membrane to illustrate plant osmosis. It is advisable if time permits to set up the egg experiment also for its general biologic value.

As to the value of osmosis demonstrations in elementary college courses in botany, we use

[1] Osterhout, W. J. V., "Experiments with Plants," 1906.

[2] Shull, C. A., "Semipermeability of Seed Coats," *Bot. Gaz.*, LVI., 183, 1913.

them in our laboratory to emphasize differences in diffusibility between crystalloid and colloid solutions in studying the nature of protoplasm, to show the method of entrance of solutions into root hairs, and to illustrate a factor in the ascent of sap in stems. The experiments never grow old to the student of inquiring mind.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

SECTION D—ENGINEERING

THE first session was held in the morning of Thursday, December 28, in the engineering building, Columbia University, Vice-president Dr. Henry M. Howe in the chair, with an attendance of about 65. It was announced that the sectional committee had recommended for election to the general committee for the office of vice-president, Dr. Henry S. Drinker, president of Lehigh University, South Bethlehem, Pa. The following officers were elected by the Section:

Member of Council—Professor F. L. Bishop, of the University of Pittsburgh.

Member of General Committee—Professor D. D. Jackson, of Columbia University.

Member of Sectional Committee—Professor A. E. Burton, of the Massachusetts Institute of Technology.

The program of the session, which was devoted to sanitary engineering, was as follows:

The Treatment of Public Water Supplies: NICHOLAS S. HILL, JR.

The Disposal of Sewage by Dilution in New York Harbor Waters: D. D. JACKSON and R. H. BROWN.

Pure Water and the Public Health: GEORGE A. JOHNSON.

Recent Developments in the Design of Garbage Disposal Plants: GUSTAVE R. TUSKA.

The Sterilization of Tannery Wastes: D. D. JACKSON and A. M. BUSWELL.

The Situation regarding the Main Drainage of New York City: KENNETH ALLEN.

The second session was held on the afternoon of Thursday, December 28, in the assembly hall of the Automobile Club of America, under the joint auspices of the Society for the Promotion of Engineering Education, the Automobile Club of America, the National Highways Association, the National Automobile Chamber of Commerce, and Section D, American Association for the Advancement of Science. This session was devoted to highway engineering education. Mr. William O. Wiley, treasurer of the Society for the Promotion of Engineering Education, was in the chair. The attendance was about 85.

The program of the session was as follows:

The Value of a Training in the Humanities for Engineers: NELSON P. LEWIS.

What is Best in Engineering Education: H. H. HIGBIE.

Education in engineering should be primarily a systematic cultivation of the natural abilities of the individual student, and should be concerned only secondarily with acquiring knowledge of facts or of methods of using them. The greatest services which a college may undertake to perform for its students are:

First: To develop traits and habits which produce a creditable and attractive personal address.

Second: To establish a habit of thinking independently, clearly, accurately, usefully and pleasurably.

Third: To ingrain thoroughly some fundamental principles of science to base thoughts upon.

Fourth: To exalt the personal ideals and morals of a student.

Colleges of engineering commonly attempt to impart other things, which the student is not likely to assimilate, namely:

1. Experience and judgment in the applications of scientific principles to practical problems.

2. Special knowledge, expertness or speed in any particular branch of science or art.

3. Equipment of knowledge adequate for any demand without some measure of ingenuity or adaptive ability on the students' part.

Any notable improvements in the functioning of an engineering college will depend upon:

1. Personality, interest, enthusiasm of the teachers and their contact with the students.

2. More general and serious study of educational problems by teachers of engineering.

3. Greater adaptability of the educational system to the individual student.

Criticisms and suggestions are made concerning the teaching of English and foreign languages, specialized or professional courses and mathematics.

Essential Qualifications of Highway Engineers for State, County and Municipal Departments: E. A. STEVENS.

[1] New York, December 28–29, 1916.