THE report for 1943–44 of the Committee on Marine Ecology as Related to Paleontology of the Division of Geology and Geography of the National Research Council, of which Dr. Henry S. Ladd is chairman, has been issued in bound mimeographed form.

CHARLES BROTHERTON has given the University of Leeds £1,000 a year for seven years for the establishment of a Brotherton research fellowship in physical chemistry tenable in the department of color chemistry and dyeing; £1,000 a year for seven years for the establishment of a new lectureship in chemical engineering in the department of coal gas and fuel industries, and an additional sum of £1,000 to each of the two departments for the purchase of equipment.

A NEW map of Soviet Russia, the first and only detailed chart of that country with place names in English, has been issued by the National Geographic Society.

DISCUSSION

UTILIZATION OF "PORE SPACES" OF SEMI-PERMEABLE MEMBRANES[1]

DURING the summer of 1941 it was desired to prepare flexible, opaque, but highly reflective, smooth surfaces in order to make a shutter curtain for a reflex type camera without having a separate mirror. Metallic foils were discarded for many reasons, and an attempt was made to deposit metallic silver directly on a flexible plastic.

"Cellophane" was the plastic selected upon which to try the plating process. Several reasons dictated this choice, namely, its flexibility, its relatively great strength in relation to thickness and the ease of obtaining fairly large sheets. The two commonest methods of depositing silver films on glass, *i.e.,* the ammoniated silver nitrate *vs.* acid sucrose process, and the Rochelle salt process, were tried. Silver was deposited when the solutions were poured over the membrane, but the film of metal did not seem to be quite as adherent on the plastic as it is on glass and was entirely too delicate even when protected by a coating of lacquer. The idea was discarded; but later the question came up as to what would happen if the reacting solutions were separated by the membrane. A trial was made, using the ammoniated silver and acid sucrose solutions. A brown deposit began forming in the membrane almost at once, the color depth increasing and gradually changing to a metallic greyish black. At about this point metallic silver (judged by color) began depositing upon both surfaces. The same sequence of events occurred with the Rochelle salt process. Examination of the brown deposit seemed to indicate that it was composed of finely divided metallic silver.

These films with their surface coatings were not satisfactory for the purpose in mind. A third method of obtaining silver films, that is, the one using triethanolamine solution, was tried. In this case, a metallic silver layer was eventually built up that was not on the surface of the membrane. This piece of plastic served admirably as a mirror that would roll up and stand quite a bit of abuse before finally disintegrating.

[1] From the Department of Ophthalmology, Washington University, and the Oscar Johnson Institute.

The foregoing led quite naturally to speculation regarding other metals, and copper was selected as being one of the easiest to deposit. A solution of copper sulfate was separated from a solution of colloidal iron by a membrane. Nothing resulted from this experiment. Then, finely divided metallic iron was substituted for the colloidal suspension and a deposit having a metallic lavender-brown color was formed within the membrane. The particles in this case were very gross and irregular in size, shape and arrangement. The experiments cited led to speculation concerning membranes other than Cellophane and resultants other than metallic deposits.

The author, being interested in photography, selected the photo-sensitive silver salts for the next group of experiments and somewhat more attention was paid to conditions. Half molar solutions were prepared of silver nitrate and of the four halogen sodium salts. Formation of the silver salt was done by covering the bottom of a porcelain-lined developing pan with the silver nitrate solution and laying a large sheet of Cellophane in the pan in such a manner as to prevent direct contact of the sodium salt solution with the silver nitrate. The sodium salt solution was then poured over the Cellophane and a creamy deposit at once began to form within the membrane. The longest practical exposure was roughly thirty seconds, by which time the reaction had proceeded to the exterior layers, and the halogen silver salt made a mass on both surfaces that was adherent and could only be removed with difficulty. The salt-bearing membranes were washed thoroughly in distilled water and dried with some stretching. The Cellophane used in all these experiments came from box wrappings of one sort or another and was so thin that drying had to be done carefully or too much wrinkling occurred. The light-sensitive silver salt membranes were all prepared in the dark-room using a Wratten 'OA' safe light for illumination. After drying, the films were exposed in direct contact with a standard photographic negative for a slightly shorter time than would be used for a "contrast" lantern slide plate. Development was carried out using Eastman's D-72 formula, fixing in Eastman's F-5 acid fixative formula, washing in tap water and drying. It was found by trial that the D-72 concentrate had to be diluted at least fifty times to work slowly enough to stop the action before overdevelopment occurred and the time of immersion in the developer had to be cut to a matter of seconds. The film procedure finally became one of immersion only long enough for complete wetting, immediate removal and rinsing in water, then observing and quickly stopping the developing action by acid fixative. Fixation was arbitrarily set for five minutes and washing for ten minutes. Drying was by wiping with a towel and manual manipulation to reduce wrinkling. Images were present in all trials for the silver fluoride, silver chloride, silver bromide and silver iodide. The images were within the membranes and very distinct.

The extreme rapidity of development may possibly be due to a radical overexposure instead of to the fact that the developing agent can act through both surfaces of the film. Experiments are under way to determine the validity of this premise.

Examining the image under an oil immersion objective and a 15 × ocular, the combination having a total magnification of 1400 ×, it was seen that the metallic silver particles were very small in size, were regularly shaped like balls, and arranged in what appeared to be an overlapping lattice. The silver particles seemed to be much more regular in size, shape and arrangement than in the standard photographic emulsion. The particles appeared evenly dispersed through the thickness of the membrane in more or less definite layers, each layer slightly different in position from the one above and the one below.

With the foregoing data at hand speculation as to various other membranous materials was aroused. Selecting silver chloride as an easily handled material for deposition, the procedure was tried on freshly prepared collodion, fish swim bladders, "Viscose" sausage tubing and shell membrane from eggs. The reaction proceeded in the same manner as with Cellophane, and upon exposure and development the metallic silver granules were always found in a definite arrangement. The arrangement of the silver granules varied, however, seemingly being dependent on the material utilized as a membrane. With this in mind it is desirable to try the procedure with materials such as gelatine and agar sheets with the prospect of perhaps really seeing the structure of such materials.

It was believed that the same procedure might be used wherever the product of the reaction is less soluble than the reacting substances. With this in mind a very few experiments were done with salts producing relatively insoluble products. Whenever the procedure was tried, it worked as expected, producing granules of very small size always arranged in a pattern similar to that formed with the silver salt in the same membrane.

A matter for speculation is whether a protein solution on one side with a reacting substance calculated to produce a relatively insoluble protein salt or material on the other will form the insoluble substance within the membrane or upon the surface.

It was thought that this process should be submitted for publication as it provides a tool that possibly may not have occurred to those investigating the nature of permeable or semi-permeable membranes. The process might also serve as another means of providing a support and dispersal member for catalytic agents. It might provide a means of introducing therapeutic materials where slow or controlled absorption is desired. The photographic films produced seem to offer something new, however, in the fine grain effect as no usable enlargement shows any granulation; and the rapidity of development, fixing, washing and drying produces a picture in an extremely short time.

I wish to give thanks to Dr. Lawrence Stout, professor of chemical engineering, Washington University, for the suggestion of the possible explanation of the rapidity of development of the photographic film.

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IMPROBABILITY AND IMPOSSIBILITY

IN a communication under the above caption Lecomte du Noüy[1] points out that, after replacing the word "impossible" by "highly improbable," modern physics has, through Heisenberg's principle of indeterminancy, restored the significance of the "impossible" to the microscopic field. Then he goes on to state that there is at least one impossibility in the microscopic field which is implied by the question, "What is the color of the emulsion of an unexposed film?"

It seems to me that this question, properly understood, raises no issue of possibility or impossibility. It does not satisfy Professor P. W. Bridgman's "operational" test, and consequently belongs to that category which he has characterized as meaningless questions.[2] The question, "What color will the emulsion of a particular photographic plate have after it has been exposed to light?" has a meaning, because it may have an answer on the basis of experience and knowledge of the photochemical properties of the emulsion. But du Noüy's question, with the emphasis on the word "is," has no meaning.

[1] Du Noüy, SCIENCE, 100: 334, 1944.
[2] Bridgman, "The Logic of Modern Physics," p. 30; Macmillan Co., 1927.