meter in area. The screen is then suspended over a large pan and water is sprinkled upon the plants at predetermined rates. The interception capacity of the plants is calculated as before. The effect of wind movement is readily shown by use of an electric fan. Thus the plants are under practically natural conditions. It is not claimed that all the factors which characterize a rain storm are present, but the methods lend themselves to use under such conditions. These experiments were performed during years of extreme drought.

The amount of water intercepted by herbaceous plants is often surprisingly large. Wheat, when fully developed, was found to hold from 50 to nearly 80 per cent. of the water applied, depending upon the rate of application. An open growth of needle grass (*Stipa spartea*) in upland prairie intercepted approximately 50 per cent. of the water applied at the rate of one-fourth inch in 30 minutes. Prairie dropseed (*Sporobolus heterolepis*) gave somewhat similar results, but little bluestem (*Andropogon scoparius*) intercepted from 50 to 60 per cent. of the water applied at the rate of one-half inch in 30 minutes. In low prairie, composed chiefly of big bluestem (*A. furcatus*) and tall panic grass (*Panicum virgatum*), with flower stalks fully developed, the interception at different rates of application was one inch in an hour, 47 per cent.; one-half inch in 30 minutes, 57 per cent.; one-fourth inch, 67 per cent.; one-eighth inch, 81 per cent. for similar periods. Bind weed (*Convolvulus arvense*) intercepted 17 per cent. of water applied at the rate of one-half inch in 30 minutes, 30 per cent. when one-fourth inch was applied, and 50 per cent. when one-eighth inch was used. For buffalo grass (*Buchloe dactyloides*) the results were: one-half inch in thirty minutes, 31 per cent.; one-fourth inch, 46 per cent.; and one-eighth inch, 74 per cent. In all the experiments it was found that wind, through its influence upon evaporation, had a marked effect upon the percentage of interception.

Results thus far obtained show that the amount of water held upon the surfaces of leaf and stem and prevented from reaching the soil is very great. They clearly show that the amount of water thus held depends largely upon the rate at which the water falls and, to a certain extent, upon the environmental conditions, especially wind movement. In the plants studied, little water ran down the stems and thus reached the soil. So far as use to the vegetation is concerned, the water intercepted represents a loss, which over large areas becomes enormous. For example, when a thick growth of bindweed intercepts 13 per cent. of one-half inch of water in 30 minutes, the amount withheld by the plants from reaching the soil is 7.5 tons per acre. Wheat in intercepting 52 per cent. of a similar rainfall causes a loss of over 29 tons of water. When an inch of water falls during an hour, buffalo grass intercepts over 28 tons per acre, while prairie composed chiefly of big bluestem may intercept as much as 53 tons per acre.

O. R. CLARK

UNIVERSITY OF NEBRASKA

RENEWAL OF MULTIPLE PRECIPITIN PRODUCTION ON INJECTION OF ONE ANTIGEN IN RABBITS SUCCESSIVELY IMMUNIZED WITH MANY ANTIGENS

FIFTEEN antigens,[1] adsorbed on aluminum hydroxide,[2] were injected one by one at intervals of about seven days into the muscles of two rabbits. The amounts injected varied from 7.5 to 25 cc of aluminum hydroxide, the antigen strength of which was 1 per cent. Before each injection the blood serum, except in two or three instances, was tested for precipitin for the antigen about to be injected and for precipitins for the antigens previously injected. The first injection was made on January 8 and the last on May 23, 1936. There was good precipitin production in response to all the antigens except the last three injected, namely, human hemoglobin, Bence-Jones protein and beef lens. So far as indicated by the tests the injections of antigen did not reduce the precipitins in the serum for antigens previously introduced, but as no tests were made before seven days after each injection, the possibility of an earlier fall in the content can not be excluded.

Following the last injection in rabbit 1 precipitin after precipitin disappeared from the serum. On October 27 no precipitins were demonstrable, but in February, 1937, the tests for ovalbumin, human albumin and beef pseudo-globulin were positive. On February 23 10 cc of a 1 per cent solution of ovalbumin in salt solution were injected intramuscularly, and during the next few weeks five precipitins which had been absent for several months reappeared in the serum.

In rabbit 2 the precipitins disappeared more slowly. On March 23 tests were obtained for six precipitins. On March 24 15 cc of 1 per cent. solution of Bence-Jones protein 1 were injected intravenously, and during the next week the serum reacted with all the antigens that had been injected previously.

[1] Ovalbumin, human albumin, beef pseudoglobulin, human pseudoglobulin, beef albumin, horse pseudoglobulin, chicken blood albumin, Bence-Jones protein 2, dog albumin, hog thyroglobulin, beef hemoglobin, guinea pig serum, human hemoglobin, Bence-Jones protein 1, beef lens. The two Bence-Jones proteins used are different antigenically.

[2] Hektoen, Ludvig and Welker, William H. Precipitin production in rabbits following intramuscular injection of antigens adsorbed by aluminum hydroxide. *Jour. Infect. Dis.*, 53: 309, 1933.

SUMMARY

Multiple precipitin formation may be induced in the rabbit by the successive introduction of different antigens, and many precipitins may exist simultaneously in the blood for some time. Precipitins no longer demonstrable in the blood of a rabbit subjected to multiple successive immunization may reappear on the injection of only one of the antigens previously injected. Whether an unused antigen would have the same effect has not been determined.

LUDVIG HEKTOEN
WM. H. WELKER

JOHN MCCORMICK INSTITUTE FOR INFECTIOUS DISEASES AND DEPARTMENT OF PHYSIOLOGICAL CHEMISTRY
COLLEGE OF MEDICINE,
UNIVERSITY OF ILLINOIS,
CHICAGO, ILL.

CATALYTIC REDUCTION AND DEACETYLATION OF THE METHYL ESTER OF HEXACETYL "β"-METHYLALDOBIONIDE TO 6-GLUCOSIDO-β-METHYL-GALACTOSIDE

THE methyl ester of "β"-methylaldobionide, from gum arabic, was acetylated and the new crystalline hexa-acetate

(having m.p. = 140°, $[\alpha]_D^{23} = -54.3°$ (in acetone)
and the following composition:
Found: C 49.24, H 5.8, OCH_3 10.01, $COCH_3$ 40.96
$C_{26}H_{36}O_{18}$
requires " 49.04, " 5.7, " 9.75, " 40.57)

has been reduced and deacetylated in methyl alcohol solution in an atmosphere of hydrogen, in the presence of copper chromite catalyst, at a temperature of 175° and pressure of 3,600 pounds per sq. in. during 5 hours. The product obtained was quite free from uronic acid (naphthoresorcinol test) and had the following composition:

Found: C 44.25, H 6.9, OCH_3 9.84
$C_{13}H_{24}O_{11}$ requires " 43.80, " 6.8, " 8.71

It had $[\alpha]_D^{25} = -61.6°$ (in water), thus indicating that the product is probably the β-methyl-glycoside of 6-glucosido-galactose.

P. A. LEVENE
R. STUART TIPSON

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH,
NEW YORK

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ON SECURING LARGE QUANTITIES OF DIATOMS FROM THE SEA FOR CHEMICAL ANALYSIS[1]

A KNOWLEDGE of the chemical composition of marine diatoms is desirable because of the essential role these organisms play each year in the constructive part of the food cycle of the sea and because of the importance diatom substance may have had in the formation of petroleum deposits. Although countless billions of diatoms may exist in small areas of the ocean, their minute size makes it extremely difficult to obtain any considerable quantity. Chief among the difficulties encountered are the very large volumes of water which must be strained and the rapid clogging of the filtering surfaces by the diatom cells. During the past summer at the Woods Hole Oceanographic Institution methods of circumventing these difficulties were explored.

The use of a large silk net towed from a boat was found more effective than the pumping method,[2] provided that the proper size mesh was selected for the type of diatoms desired. Another method, consisting of culturing a pure strain of diatoms on a large scale, is on trial by Mr. Bostwick Ketchum at the Harvard Biological Laboratories. However, exceedingly few species have been cultured successfully by any one. The advantages of procuring the diatoms directly from the sea are that any types occurring in great abundance (and hence important in the economy of the sea) can be obtained, that large quantities are procurable within a short time (at least six nets could be used simultaneously from a boat), and, since no danger exists of changes due to artificial conditions, the chemical constitution of the organisms secured will be as in nature.

To permit any useful interpretation of the chemical analysis of the material obtained, a certain degree of purity of the catch is required. If particles of detritus or protozoans *of the same size* as the diatoms are abundant in the water, it is obviously impossible to obtain a large quantity of uncontaminated diatom material by simple straining. Another time or place must be sought. In cases in which the detritus is very finely divided, it can be avoided by the use of the coarsest net which will retain the diatoms. However, copepods or other crustacea are almost sure to be encountered, and, because of their larger size, even small numbers of these animals would be a serious contamination quantitatively. Success in excluding organisms larger than diatoms was attained through the use of a cone of coarser silk placed over the mouth of the net and towed apex foremost. The mesh of this

[1] Contribution No. 164, Woods Hole Oceanographic Institution.

[2] However, pumps or sea-cocks have been found useful for collection of plankton in smaller quantities. *Cf.* L. D. Phifer, SCIENCE, 79: 298, 1934.