Die Binnengewässer Mitteleuropas. BY AUGUST THIENEMANN. Bd. I, 1925, 255 pp. Published by E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart. Brochure Mk. 16.00, bound Mk. 17.50.

THIS is the first volume of a series of seven which will deal with the physical, chemical and biological features of the inland waters of central Europe; it presents the hydrobiological characteristics of these inland waters and thus serves as an introduction to the six volumes which are to follow.

The book is divided into five sections in which the following types of water are discussed: (a) Underground waters, (b) cold fresh-water springs, (c) flowing waters, (d) standing waters and (e) thermal and brackish waters. The introduction is devoted to a discussion of the nature of limnology. This is followed by fifty-seven pages relating to the first three sections, 138 pages to the fourth and twelve pages to the fifth. More than half of the text, therefore, deals with the various phases of limnology. The ecological features of the different types of aquatic habitats are especially emphasized.

The underground waters are characterized by the absence of light and this affects the green plants adversely but certain forms of algae are able to thrive with minimal amounts of light. The absence of light also affects the animal population, giving rise to a special group of organisms with degenerate eyes. Two other important factors are the relatively low but constant temperature of the water and the scarcity of food.

Spring waters also have a low but constant temperature throughout the year, and they are frequently very deficient in dissolved oxygen. They possess a distinctive fauna which is allied to the blind forms of the underground waters on the one hand and to some forms found in standing waters on the other hand. Several forms found in springs do not attain as large a size as they do in other waters.

The chief factor in flowing water is the current; it affects the variety as well as the shape of the organisms. In the Rhine River, for example, the number of species of fish is greater toward the mouth where the current is slow than toward the source where the current is swift. Also the body form of fishes regularly populating flowing water is different from that of fishes which normally occupy standing water. Some of the inhabitants of swift-flowing streams possess structures for attachment to the substratum so that they will not be swept away by the current.

Lakes, ponds, pools and bogs are considered under the title of standing waters, but the chief part of the section treats of lakes. The temperature, transparency, color and chemistry of lake waters are discussed in some detail. This is followed by a consideration of the different depth regions of lakes in relation to the organisms living therein and of the effect of physical and chemical factors on the vertical and horizontal distribution of these organisms. The different types of lakes are also considered.

The fifth section deals with thermal and brackish waters in relation to their biota.

An excellent bibliography covering twenty pages is given at the end of the book.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE RING METHOD FOR SURFACE TENSION MEASUREMENT

SOME data which have been published and some more recently obtained in this laboratory by the use of the ring method for determining surface tensions are not entirely in agreement with some of the assumptions which have been made concerning this method. Since many workers consider the ring method to be entirely reliable and recommend it as the only method by which the surface tension of colloidal solutions can be accurately measured, it is of importance to again emphasize the fact that the ring method as it is at present being used is not as reliable as is being assumed.

Cantor[1] has shown that to obtain reliable data the ring should be kept rigid and the force required for detaching the ring from the liquid should be applied on the liquid and not on the ring, and has further shown that the diameter of the wire which is used for making the ring should be so small as to be negligible in comparison with the other dimensions which come into consideration. Sondhaus[2] who first introduced the ring method for surface tension measurements observed that too small a ring must not be used. All the rings which he used were much larger than any which are now used and some were twenty centimeters in diameter. A study of the data which he obtained in measuring the surface tension of distilled water with platinum rings, which were 4.6 and 6.1 centimeters in diameter, shows that the results which were obtained with the larger ring are usually 2 or 3 per cent. higher. Edser[3] has more recently observed that when a ring made of platinum wire which is 0.3 millimeters in diameter is used, the results obtained are about 8 per cent. too high.

A few of the experiments made with the use of a du Nouy tensiometer in measuring the surface tension of water are illustrated in Figure 1. Letting

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[1] *Wied. Ann.*, 47 (1892), 399.

[2] *Ann. der Physik. Chem.*, 8 (1878), 266.

[3] Fourth Report on Colloidal Chemistry (Brit. Assn. Adv. Sci.) (1922), 284.

$p = \frac{F}{4\pi r}$, when F is equal to the number of dynes necessary to bring about detachment, r the radius of the wire and R the radius of the ring, it was found that as r varied from 0.0160 to 0.0405 centimeters, the value of p varied more than nine dynes and that it varied more than sixteen dynes as the value of $4\pi R$ varied from 4,120 to 11,808 centimeters. The technique introduced by Klopsteg,[4] though obviously correct, does not eliminate these variations, and corrections according to the correction factors of Cantor or MacDougall[5] are negligible in comparison. Variations in the case of benzene were quite as regular but not nearly as great.

McDougall[5] found that p diminishes as r increases. In the present experiments it is to be observed that p increases as either r or R increases. The data obtained with the ring supplied with the instrument apparently lie in that part of the curves where a change in the value of r or R produces an almost maximum effect. The writer can not offer a correction factor for obtaining correct surface tension values for the data obtained by the ring method, nor is it possible to review all the deductions given by Cantor and MacDougall for the ring method and of Lohnstein[6] and Lenard[7] for similar methods. Aside from any mathematical deduction, it is evident that the approximately correct values obtained for the surface tension of water with the ring supplied with the instrument are the result of the cancellation of equal and opposite errors. Values obtained for benzene with the same ring are too high.

It is claimed that only the ring method will give absolute values for the surface tension of colloidal solutions. Since the surface tension of many colloidal solutions changes with time and does not readily reach an equilibrium value, no method can be used for obtaining absolute values in the case of such solutions. In previous papers[8] it was shown by three methods, one of which was the ring method, that the surface tension of colloidal solutions changes with time according to the equation $\sigma = a/t^n$. Until more is known of the conditions under which the constant n changes it will be difficult to draw comparisons relative to definite periods of time and still more difficult to compare approximate conditions of equilibrium. Two hours can not be assumed as sufficient for reaching a state of even approximate equilibrium. Frequently the change following an initial period of two hours is several times as great as it was in this initial period. Some of the data given as typical for the ring method indicate that the change during a second period of two hours is nearly equal to that of the second half of the initial two hour period. It is therefore futile to try to obtain absolute surface tension values for many colloidal solutions. A definite time period should not be indiscriminately chosen as one in which even an approximate equilibrium point will be reached and the utmost discrimination must be exercised in comparing data which are relative to definite periods of time.

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SPECIAL ARTICLES

BUTTERMILK AS A FERTILIZER FOR BLUEBERRIES[1]

IN casting about for acid, organic, nitrogenous fertilizers for blueberries and other acid-soil plants, I long ago considered buttermilk as one of the materials with which to experiment. My attention was again called to the subject last year by Herman E. Gasch, a Washington lawyer, farmer and man of understanding, who showed me a newly planted and thriving holly tree and told me, among other things, that he had given it a liberal application of buttermilk.

Plants in suitable condition for a buttermilk experiment became available in May of this year. They were blueberry seedlings that had been potted in January, 1926, in two-inch porous earthenware pots, in the standard soil mixture for the greenhouse culture of blueberries, rhododendrons and azaleas, two parts of upland peat and one part of sand. After about four months in a greenhouse maintained at a temperature of 55° Fahrenheit at night and 70° in the daytime, the growth of the plants had begun to slacken, as is normal under these conditions.

On May 14 a teaspoonful (about 5 cc) of buttermilk was applied to each of sixteen of these plants. Each pot contained about 50 cc of soil. These pots were plunged in sand in a flat containing thirty-nine other exactly similar, but untreated, plants.

Within ten days the leaves of the plants to which the buttermilk had been given had taken on a darker green color than those of the untreated plants. In two weeks the buttermilk plants were in active growth, some of them putting out new strong basal shoots, some branching from the upper axils, some pushing

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[4] SCIENCE, 60 (1924), 319.

[5] SCIENCE, 62 (1925), 290.

[6] *Ziet. Physik. Chem.*, 10 (1892), 504.

[7] *Ann. Physik.*, 13 (1924), 385.

[8] *Jour. Phys. Chem.*, 29 (1925), 1137.

[1] This early announcement of greenhouse experiments will, it is hoped, enable others to make similar fertilizer experiments out of doors with buttermilk or other by-products of milk, on blueberries, rhododendrons, azaleas, and other acid-soil plants during the present season.