the Alaskan investigation. The value of additions to equipment of the stations in 1898 is estimated as follows: Buildings, $109,851.65; libraries, $11,700.73; apparatus, $19,195.43; farm implements, $10,800.27; live stock, $13,151.33; miscellaneous, $11,972.97; total, $176,469.41.

The stations employ 669 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 75; chemists, 148; agriculturists, 71; experts in animal husbandry, 10; horticulturists, 77; farm foremen, 29; dairymen, 21; botanists, 50; entomologists, 46; veterinarians, 26; meteorologists, 20; biologists, 11; physicists, 11; geologists, 6; mycologists and bacteriologists, 19; irrigation engineers, 7; in charge of substations, 15; secretaries and treasurers, 23; librarians, 10, and clerks, 46. There are also 21 persons classified under the head of "miscellaneous," including superintendents of gardens, grounds and buildings, apiarists, herdsmen, etc. Three hundred and five station officers do more or less teaching in the colleges with which the stations are connected.

During 1898 the stations published 406 annual reports and bulletins. Besides regular reports and bulletins, a number of the stations issued press bulletins, which were widely reproduced in the agricultural and county papers. The mailing lists of the stations now aggregate half a million names. Correspondence with farmers steadily increases, and calls upon station officers for public addresses at institutes and other meetings of farmers are more numerous each year. The station officers continue to contribute many articles on special topics to agricultural and scientific journals. A number of books on agricultural subjects, written by station officers, have been published during the past year.

A. C. True.

U. S. Department of Agriculture.

PHYSIOLOGICAL OSMOSIS.

In going over this subject I have discovered a very simple method, which I would offer as an improvement on that of van't Hoff, referred to, and its results given by Starling in Schaefer's 'Physiology.'

All methods as to osmotic pressure are an application of the discovery that it is the largeness or smallness of the chemical molecules of solutes (matters in solution) that determines whether they shall be estopped by or shall pass through membranes. Citing common-places of chemistry, we know that a gram-molecule of hydrogen gas, with a numerical value of 2, has the same volume as a gram-molecule of oxygen, weighing 32 per molecule, and as a gram-molecule of cane sugar dissolved in water, having a molecular weight of 342 and when in solution acting like a gas. The common volume of a gram-molecule of each of these substances, at 0°C. and ordinary barometric pressure, is 22.32 liters; if the gases be compressed to the volume of 1 liter they will exercise a pressure of 22.32 atmospheres per gram-molecule. This is the result with all solutions in water when taken according to their molecular pressure. But it will not apply to electrolytes, as these are broken up by the water; thus for sodium chlorid the value is 1.6 times this amount.

Taking as an example a 1 per cent. solution of cane-sugar in water, a gram-molecule, that is 342 grams, of the sugar are dissolved in 34,200 grams of water, or $\frac{1}{342}$ of a gram-molecule in a liter of water. This will, therefore, exert $\frac{10}{342}$ of 22.32 atmospheres of pressure; or taking 10.33 meters of water pressure for an atmosphere, we find from the osmotic pressure of the solution at 0°C. $p = \frac{10}{342} \times 22.32 \times 10.33 = 6.748$ meters of water-pressure.

At the ordinary temperature of the body, 37°C., this will be increased by $\frac{37}{273}$ of itself, giving 7.662 water-meters, or about 25 feet of water-pressure.

For any other solute than sugar we have only to substitute its molecular weight for the denomination 342 in the above work. Substituting 2 for it, for hydrogen, the result is 1153 water-meters, a forcible token of its lively diffusibility.

The Freezing-Point.—Though this has no connection with physiology, the lowering of the freezing-point in solution is cited by Starling as a step towards finding osmotic-pressure, which we have seen to be determinable in a less troublesome way. We give the converse case; having found the pressure, to ascertain by its aid the freezing point of a 1 p. c. solution of cane-sugar.

The law of thermodynamics gives this proportion:

$$\frac{\text{Work done}}{\text{Heat during it}} = \frac{\text{Lowering } (\triangle) \text{ of Total Heat}}{\text{Total Heat.}}$$

In this case the work done is 6.748 water-meters-pressure (as was found above). The heat doing it is the latent part of water, 79.9 calories per gram, which is reduced to water-meters-pressure by multiplying by 427.

The total heat is the absolute temperature at 0°C.; this is 273. Thus the proportion becomes

$$\frac{6.748}{427\ (79.9)} = \frac{\triangle}{273},$$

giving $\triangle = 0^{\circ}.054$ C. This result is substantially identical with that cited by Starling from van't Hoff, and signifies that the particular solution of sugar in water lowers the freezing-point more than one-twentieth of a degree. If the solution had represented a gram-molecule of sugar in a liter of water the depression of the freezing-point would be nearly 2°C., a constant well-known to physicists.

Writers on physiology usually state that processes of absorption within the body are more rapid than can be fully explained by experiments on diffusion. A partial explanation of this peculiarity will, I think, be found in the fact that experiments are made on dead and comparatively rigid membranes, and the living membranes of the body are almost fluid in their softness. Whether osmosis be by a transitory combination or by passing through temporary pores, it involves in the living body a minimum of friction. We know how much more rapidly blood can pass through flexible, living vessels than through rigid tubes.

(I am indebted to my colleague Professor E. H. Loomis for advice.)

GEORGE MACLOSKIE.
PRINCETON UNIVERSITY.
January 5, 1899.

PROFESSIONAL SCHOOLS VS. BUSINESS.

AN exceedingly interesting and instructive experiment has been in progress during the last few years at Sibley College, Cornell University, the outcome of which will perhaps have peculiar interest for all who are concerned with education and professional training, the data of which experiment are exhibited in the accompanying diagram, showing the growth in numbers of that college from its date of reorganization as a professional school, in 1885, to the present time. The diagram is taken from the paper read before the Association of Promotion of Engineering Education, at the Boston meeting of 1898, by the writer.

Up to the year 1885 Sibley College was without expert direction, a definite policy, a settled curriculum or a systematically organized faculty. It had been established as a 'school of the mechanic arts' for many years, but had not graduated a hundred students in its whole career. In 1885 the Trustees of the University found themselves in a position to undertake the work