neva Institute of Natural Science, announces a gift to the institute of $500 from the Lake Geneva Property Owners Association for the study of lake nuisances and limnological sequences resulting from pollution. A $300 fellowship to study fishery biology in Lake Geneva, Wisconsin, has been established by Frank W. Schwinn. Applications for this fellowship for the summer of 1941 should be sent to Dr. Hasler, Department of Zoology, University of Wisconsin.

THE *Journal* of the American Medical Association reports that Meharry Medical College at Nashville is making a campaign to raise more than two million dollars for an endowment fund. The General Education Board, which has been contributing toward the annual operating budget of the college, has announced that it will not continue this subsidy after this year. The board has offered conditionally, however, to make endowment grants amounting to $3,700,000 if the college can collect $1,700,000 from other sources. Of this amount $1,500,000 must be raised by July 1. The current endowment is about $800,000. A committee representing medical, educational and journalistic activities is sponsoring the campaign. Dr. Abraham Flexner is national chairman of the endowment program.

DISCUSSION

THE AGE OF JURASSIC DINOSAURS

A RECENT number of *Natural History* contains[1] a very interesting account of the discovery and collection of footprints of a gigantic Sauropod dinosaur identified as those of Brontosaurus, from the Glen Rose formation near Glen Rose, Somervell County, Texas. The American Museum, we are told, is installing these footprints under their excellent mounted Brontosaurus in the new Jurassic Hall. Brontosaurus, Diplodocus, etc., come from the Morrison formation of Colorado. The age of the Morrison was decided to be Jurassic by the late O. C. Marsh, largely because of his belief that the English Wealden was Jurassic, which has long since been disproved. In a great many parts of the world there exist continental beds of greater or less chronological magnitude between the latest marine Jurassic and the earliest marine Lower Cretaceous, and these always have given rise to differences of opinion and more or less controversy as to their age.

To those unfamiliar with Texas geology it may be said that the Glen Rose formation near Glen Rose from which the tracks were collected is thinner than it is farther east, and I am assured by Dr. E. H. Sellards that the tracks actually occur at a horizon which is rather late in Glen Rose time.

The age of the Lower Cretaceous of Texas has been the subject of much misconception in the past, largely from the ill-advised attempts of text-book writers, such as Chamberlin and Salisbury, to substitute the provincial term Comanchean as an independent system (period) co-extensive with the Lower Cretaceous of Europe. This is contrary to the conclusion of students of Cretaceous stratigraphy and paleontology, both American and European.

The Glen Rose is the middle formation of the Trinity group and the base of the Trinity in Texas is now considered younger than the Neocomian of Europe.

In 1911 I correlated it[2] with the late Barremian and Aptian of Europe (*vide* Douville, Kilian, Suess, etc.) correlating the overlying Fredericksburg with the European Albian on the basis of the faunas, and the Washita or upper Comanchean with the European Upper Cretaceous (Cenomanian).

All this leads into the question of the age of the Morrison. I have expressed my opinion long ago,[2] and wish merely to raise the question in the present connection, that if a Jurassic dinosaur (vertebrate chronology) makes footprints at a horizon near the middle of the marine Lower Cretaceous (invertebrate chronology) where do we go from here?

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[1] R. T. Bird, *Nat. Hist.*, 47: 2, 74–81, February, 1941.

[2] E. W. Berry, Maryland Geol. Surv. Lower Cretaceous, 1911 (correlation chart).

OSMOTIC PRESSURE FOR THE PLANT PHYSIOLOGIST

SOME time ago[1] these columns carried a suggestion that the basic definition of osmotic pressure emphasize its function as the cause and not the result of osmosis. Unfortunately the writer based his argument on the erroneous premise that diffusion pressure and osmotic pressure are identical. Subsequently a student of both physiology and physical chemistry has called attention[2] to the chemist's concept of fugacity as a sound basis for understanding osmotic pressure. In line with this concept but worded in explicit terms more commonly used by biologists as a whole, the following statement is offered as a brief exposition of osmosis and the way it works in plant tissues with particular reference to osmotic pressure as the cause of osmosis:

> When water molecules are free to diffuse in an aqueous solution or in pure water, they have a certain diffusion pressure. When they move through a differentially permeable membrane as the result of a difference in diffusion pressures on the two sides of the membrane, this special

[1] H. C. Eyster, SCIENCE, 92: 171–172, 1940.

[2] S. C. Brooks, SCIENCE, 92: 428–429, 1940.

case of diffusion is called *osmosis*. The difference in diffusion pressures is therefore called *osmotic pressure,* since it is the cause of osmosis in the same way that diffusion pressure is the cause of diffusion.

Furthermore, if there is pure water on one side of the membrane, the osmotic pressure is a function or property of the aqueous solution on the other side. In this sense such a solution has an osmotic pressure wherever it is, the value of which is controlled by temperature, external pressure and the concentration of solutes.

In the case of a living plant cell and its osmotic relations, there is such a variation in the pressure of the cell wall against the cell contents that the osmotic pressure of the cell as a whole may be much less than that of the cell contents which is proportional to the concentration of solutes when the cell sap is freed from the wall pressure. The wall pressure increases the diffusion pressure of the water within the cell and thus reduces the osmotic pressure of the cell contents to that extent. The osmotic pressure of the cell contents and therefore of the cell as a whole will always be equal to the theoretical pressure (based on concentration of solutes) minus the wall pressure. Since this is the net effect of the solutes in the cell contents, the effective osmotic pressure of a cell at any moment can be called its *net osmotic pressure.* The relationship between it (N), the wall pressure (W) and the theoretical osmotic pressure of the cell contents based on solute concentration (C) is expressed by the equation $N = C - W$. Suitable modification of this equation is necessary when the cell is in contact with a tissue or a solution with an effective osmotic pressure of its own, the effect being to lower the net osmotic pressure of the cell to that extent.

Since plant tissues are characterized in general by variations in solute concentration and in turgor or wall pressures, the concept of net osmotic pressure of the cells is very useful and practical. It can often be measured directly and the measurement used in computations of either wall pressure or solute concentration if one of these is also known. To elementary students it gives the picture of balanced physical forces in living cells. Suction tension is its equivalent in value, but it has no logical connection as a scientific term.

As a statement of the same physical condition, the expression "diffusion pressure deficit" has its merits, but in actual use it is an unwieldy, negative term that makes an unnecessary reference back through the osmotic pressure idea to the basic concept of diffusion. Students find it very difficult to manage. Even by those who prefer it for some purposes, it is seldom used to express the osmotic property of a solution, probably because it actually refers to the solvent and not to the solution. Osmotic pressure is an established term for solutions and cell contents, with a natural appeal to both biologists and physical chemists. If it can be used with suitable qualifying words to describe some of the complex osmotic relations of living cells, it should be employed in the interests of uniformity among the sciences. Surely it should not be abandoned by physiologists just because it has been abused by some through lack of understanding.

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THE DEMAND FOR SCIENCE BOOKS

The publication of books on science and technology has shown a steady increase in the United States for the last decade according to statistics compiled by the Bureau of the Census.

The year 1939 thus far marks the peak of production for publishers of books on scientific and technological subjects with a total of 3,432,642 volumes. Figures for that year are the latest available, since the Census of Manufactures, covering production in all American industries, is taken only biennially. The next Census, to be conducted in 1942, will cover 1941 production.

The 1939 total represents an increase of more than a million volumes over the 1937 total of books on science and technology, 2,380,351 volumes.

Separate statistics on production of books on science and technology have been compiled by the Census Bureau biennially since 1925. They are: 1935—1,937,084; 1933—1,611,642; 1931—1,818,585; 1929—2,294,660; 1927—2,392,044; 1925—2,094,343.

The Bible, however, is still America's best seller, as is indicated by the number of Biblical volumes published. Figures covering 1939 show the annual output of Bibles, Testaments and parts of the Bible published in separate covers, to be 7,927,848 volumes, compared with 5,579,317 in 1937. Both 1937 and 1939 recorded tremendous increases in total number of Bibles printed. For earlier census years Bibles published were: 1935—591,173; 1933—666,448, and 1931—1,376,680.

The number of complete Bibles published in 1939 was 2,348,069. Testaments published separately numbered 1,268,614. Parts of the Bible (not whole Testaments) numbered 3,361,234 volumes, while an additional 969,931 Biblical volumes were not classified by text.

While the production of Bibles showed an immense increase, the publication of fiction recorded a heavy decline, 13,511,181 volumes in 1939, compared with 25,454,135 volumes in 1937.

The total number of all books published in 1939 was 180,142,492 volumes, compared with 197,359,076 volumes in 1937; 140,651,953 volumes in 1935; 110,-789,913 volumes in 1933; 154,461,622 volumes in 1931, and 214,334,423 volumes in 1929.

The largest single grouping reported was that of text-books for school use, not distributed as to subject-matter, which amounted to 63,274,758 volumes in 1939, compared with 72,771,685 volumes in 1937.