tially different fauna from that now living in North America. The Green River insects, also numerous, are strikingly different, for the most part, from those of Florissant. By a sort of paradox, the similarity of the floras lends weight to the differences in the insects. Were the floras quite different, it might be argued that they represented different altitudes or climates and could therefore be contemporaneous, for anything known to the contrary. But since the floras show so many resemblances, it appears probable that the climatic differences were not sufficiently marked to account for the differences in the insects, which must then be ascribed in large part to a considerable time interval.

In general, it must be said that insects are extremely valuable as time-markers, although their evolution in family and generic characters is very slow. They have much better characters than leaves, and the fluctuations of the insect populations have been very marked. Also many genera have died out, and their presence or absence thus becomes significant. Formerly, it could be objected that too few localities for fossil insects were known, but new ones are constantly being discovered, and the whole subject is rapidly assuming such importance that the general paleontologists can not afford to neglect it.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

THE ISOTOPIC FRACTIONATION OF WATER BY PHYSIOLOGICAL PROCESSES

UNDER the above title Washburn and Smith[1] published in this journal some data for the density of highly purified water obtained in the combustion of dry willow tree (*Salix nigra*) wood and of water from the sap of the same. The sap water was 2.8 p.p.m. heavier than normal and the water from the dry wood combustion, 3.2 p.p.m. heavier than normal. This excess density was attributed to an isotopic fractionation of hydrogen in the direction of a preferential selection of deuterium.

It is now known that oxygen of the air has a slightly higher atomic weight than the oxygen combined in Lake Michigan water[2] so that a correction of −6.0 p.p.m. should be applied to Washburn and Smith's value for the density of their dry wood water (assuming that Potomac River and Lake Michigan water have the same density). The resulting value is −2.8 p.p.m., which indicates a preferential rejection rather than a preferential selection of deuterium. However, this value of −2.8 p.p.m. is still subject to some uncertainty;[3] hence more work should be done before the conclusion can be reached that deuterium is preferentially rejected in physiological processes. Mr. R. B. Gibney of this laboratory is at present investigating the whole question.

The datum for the density of the sap water may be subject to an uncertainty involved in the fractionation of the isotopes of water during partial condensation of its vapor;[4] here again, then, it is impossible to conclude definitely that any physiological fractionation of hydrogen occurs.

MALCOLM DOLE

NORTHWESTERN UNIVERSITY

APROPOS THE NAZI EDICTS

PROBABLY no single chemist has contributed more to the advancement of world chemistry and to the chemical industry of Germany than did Adolph von Baeyer, 1835–1917. In his laboratories indigo was first synthesized.

Among his outstanding pupils were, to mention only a few, Emil Fischer, Claisen, Curtius, W. H. Perkin, Jr., Büchner, Willstätter, Vanino, Wieland, Graf Schwerin, Holleman, Nef, Gomberg, Walden, W. A. Noyes and Ipatjew. Baeyer's father was a German, his mother, Eugenie, was a Jewess, and Emil Fischer[1] writes: "Er vereinte die guten charaktereigenschaften und Fähigkeiten der germanischen und semitischen Rasse."

ROSS AIKEN GORTNER

UNIVERSITY OF MINNESOTA

QUOTATIONS

A TRIBUTE TO PAVLOV

IN the obituary notice of Professor Pavlov in the *British Medical Journal* mention will no doubt be made of the International Physiological Congress which was held in Leningrad and Moscow last August under his presidency. It was Pavlov's immense prestige and the deep affection which physiologists, the world over, had for him which made the acceptance of an invitation to the Soviet Union possible. It was Pavlov's prestige and that affection, together with the mixture of playfulness, sternness, impatience, devotion, and simplicity, which formed his character, that

[1] E. W. Washburn and E. R. Smith, SCIENCE, 79: 188, 454, 1934.

[2] M. Dole, *Jour. Chem. Phys.*, in press; *Jour. Am. Chem. Soc.*, 57: 2731, 1935.

[3] See a discussion of uncertainties involved in this work by M. Dole, *Jour. Am. Chem. Soc.*, in press.

[4] M. Dole, *Jour. Chem. Phys.*, 2: 548, 1934.

[1] *Vossische Zeitung*, No. 429, August 23, 1917; cited by Bugge in "Das Buch der grossen Chemiker," Vol. 2, p. 323, Berlin, 1930.

made the Congress so successful, and opened up what one hopes is an era of friendly relations between physiologists in Russia and in the rest of the world.

Wherever Pavlov appeared in public—whether in Leningrad, London, Boston, or elsewhere—his romantic and almost legendary figure, and the engaging simplicity and boyish humor of his bearing, were apt to evoke prolonged and enthusiastic applause. He was sometimes rather impatient of this popularity. I sat next to him at several of the plenary sessions of the Congress, and when the even course of the proceedings was disturbed by applause the old man would shake his fists repeatedly and mutter hard words until the unnecessary disturbance—as he regarded it—was at an end.

Pavlov was an old man in years, but he did not seem old in mind or in strength, and one of the memorable pictures of the Congress was of Pavlov giving his arm to a colleague, ten years older than himself, who came on the platform to address us. Partly by his age, partly by his repute, partly by his character, he was without peer among the scientists of his country, and he could be as tyrannical at one moment as he could be simple and boyish at another: but he was loved far more than he was feared. His single-hearted devotion to science and the cause of science was that of a religious man—as he was. I had remarked to him that many great Englishmen were the sons of country parsons. He proudly replied that he was the son and the grandson of a priest, and his wife was the daughter of a priest. My obvious comment that he himself was a High Priest drew chuckles of boyish pleasure.

Here is a story about him which is not generally known. About 1912 Pavlov came to Cambridge to get an honorary degree—I forget the exact occasion. The students of physiology at that time knew his name very well in connection with his work on digestion. They thought they would have to do something to improve the occasion of the degree-giving. They went to a toyshop and bought a large and life-like dog, which they proceeded to decorate with rubber stoppers, glass tubes, pieces of rubber tubing, and any other physical, chemical, or physiological appliance that they could think of. They took it to the Senate House and suspended it from gallery to gallery by a long string. As Pavlov walked away, having received his degree, they let it down to him on the string. He was highly delighted, took the dog from the string, and carried it away under his arm. Later on that day I was talking to him at a party (I think it was in the Hall of Christ's College), and he repeatedly said how delighted he was at what he thought was the greatest honor that had ever been done him! "Why, even the students know of my work!" That he continued to feel the greatness of the honor was shown by the fact that for many years he kept that dog in his study in Leningrad, as I was told by one of his colleagues more than ten years later.

One of the charming things about Pavlov was his family relationships. In his later years, whenever he went abroad, he was always accompanied by one of his sons. A lawyer son had in recent years devoted himself, I believe exclusively, to acting as his father's secretary and agent. Pavlov himself did not easily speak any language but his own, though he was able to converse, not very readily, in German. This son, however, was an extremely accomplished linguist, and accompanied his father to such meetings as that of the Permanent International Committee of the Physiological Congresses, where conversation might be carried on in at least three languages, and translated for him. I have the most vivid and charming memories of the old man and his son at these meetings, the latter taking part in the conversation in any language and rapidly giving his father in Russian the gist of all that was going on: the old man nodding and smiling and expressing his opinion with his hands and with smiles and nods all the while. The son, alas! died a few months ago from an incurable illness, having taken a very active part last August in the administrative work of the Congress and in helping his father to bear his part so effectively in public functions and in private deliberations. It must have been a very heavy blow to Pavlov, and one did not expect him really very long to survive it: one's fears were justified.

Pavlov loved his country deeply, and he worked for his country. He did not approve of all that was done in Russia, and at one time was notoriously the only man in Russia, outside a small group of politicians, who could say and do what he pleased. His prestige, at home and abroad, secured his immunity from interference. In his later years, one gathered, he became more tolerant of the system which treated him, after all, and his science very well. He realized that the Soviet régime had come to stay, and, as a man who loved his country well, was prepared to do the best that was in him for Russian science and so for Russia.

Few, if any, scientific men can have been so well known, few can have been photographed so often. He never sought for publicity or fame; he seemed to be unaware, or a little impatient of them. His popularity was inevitable—by reason of his name and achievement, and the playfulness of his humor. This popularity may have been exploited sometimes by others for other than scientific purposes, and much that has been written by others about "conditioned reflexes," in the Soviet Union and elsewhere, gives rather the impression of propaganda than of scientific fact. That

was not Pavlov's fault, and he had no part in it. He was a great and simple and completely honest man, and one who was altogether unspoilt, morally and intellectually, either by public adulation or by the reverence of his colleagues.—*A. V. Hill, in the British Medical Journal.*

SPECIAL ARTICLES

DETERMINING THE AVERAGE FIBER LENGTH IN WOOL YARNS

IN studies relating to the standardization of fabricated wools, one of the problems is that of determining the average fiber length in yarns forming the material. Inasmuch as the methods in use are far from satisfactory, a new method based on a simple principle, namely, the number of fiber ends in a given section of a sample, is presented.

Since the number of ends is twice the number of fibers, one obtains the aggregate length of all fibers, assuming them continuous, and divides the result by one half the number of ends. The latter determination is based on an average from a series of counts in random cross-sections under a microscope. Thus knowing the length (s) of any sample, the number (n) of fibers in a cross-section and the average number of ends (e), the formula for average length (l_1) is expressed by a simple equation (1)

$$l_1 = 2\ (sn/e) \quad \text{.....(1)}$$

applicable to any textile thread of yarn composed of ordinary fibers.

There are several peculiarities in yarns, however, which need consideration, one the irregular arrangement of fibers, particularly in woolens, the other the twisting of the yarn in spinning. While fibers composing a worsted are relatively long and straight, those in a woolen yarn are short and irregular in position. This irregularity usually presents some recurved fibers, particularly at the surface, and the number thus added to a cross-section gives results approximating those obtained for worsteds. In connection with the process of spinning, one may consider the fibers as helices with an angle (θ) measuring the pitch. This presents two possibilities.

If the axial fibers are not under a longitudinal tension due to spinning, one may substitute $s/\sin\theta$ for (s) in equation (1) and the average length (l_2) is indicated by equation (2).

$$l_2 = 2\ (s/\sin\theta)\ n/e \quad \text{.....(2)}$$

If, however, the axial fibers are under tension, a different mathematical treatment is needed, since the lengths of the assumed continuous fibers will vary from the lengths of the axial fibers (s) to those of the peripheral fibers ($s/\sin\theta$), the distribution about the axis corresponding to the square of the radius. Using (R) for the radius of the segment and (r) for the varying radii, the total length of all helices (Σh) is exhibited by equation (3).

$$\Sigma h = (sn/\pi R^3 \tan\theta) \int_0^R 2\pi r \sqrt{r^2 + R^2 \tan^2\theta}\ dr \quad \text{.....(3)}$$

and the average length (l_3) is shown in equation (4).

$$l_3 = 4\ sn \cdot \tan^2\theta\ (\csc^3\theta - 1)\ /3e \quad \text{.....(4)}$$

The differences in the values obtained by (1), (2) and (4) are relatively small and experiments with fibers of known length are closely in agreement with the theoretical values. Any factor for average fiber length will need a modifier, probably of an exponential nature, determined in connection with subsequent experimental work, since the increase in strength of yarns will not continue to be proportionate to the increase in fiber length.

The development of standards for materials along the lines suggested, presenting something more than arbitrary objective tests, is decidedly desirable under our present economic system. Such studies are now in progress.

The writer wishes to acknowledge his indebtedness to Dr. R. B. Allen, professor of mathematics at Kenyon College, and to Mr. Graham Walton, instructor in engineering at the University of Wisconsin, for assistance in connection with equation (3).

L. B. WALTON

KENYON COLLEGE

THE SYNTHESIS OF THE HEPTACETYL METHYL ESTER OF GENTIOBIURONIC ACID[1]

THE term "aldobionic acid" has come to be applied to those disaccharides containing a uronic acid as one of the component sugars. The aldobionic acids were first discovered among the products of hydrolysis of the specific polysaccharides of certain pathogenic microorganisms and have since been obtained from various plant gums. Apart from their chemical interest, there is evidence to believe that these sugar acids have an important function in determining the immunological specificity of encapsulated microorganisms.[2]

The chemical synthesis of aldobionic acids has awaited the development of the chemistry of the hexose-uronic acids. The recent preparation of the acetohalogen derivatives of glucuronic and galact-

[1] From the Hospital of the Rockefeller Institute for Medical Research, New York.

[2] W. F. Goebel, *Jour. Biol. Chem.*, 110: 391, 1935.