New Measurement of the Velocity of Light.[1]

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THE velocity of light is one of the most fundamental of the constants of Nature, and this fact alone would justify the attempt to measure its value with the highest possible precision. But in addition to its scientific importance, it may prove to have a practical value if the result of such a measurement can be obtained with sufficient accuracy.

The mean of the various measurements thus far attempted is 186,330 miles per second, with an uncertainty of twenty or thirty miles. If this uncertainty could be reduced to one mile per second, the timing of light could be utilised to obtain distances between stations from 50 to 100 miles apart far more expeditiously and with an order of accuracy at least as great as that obtainable by the usual method of triangulation. Indeed, there are possibilities of utilising the velocity of light in cases where triangulation would be difficult or impossible.

An invitation tendered by Dr. G. E. Hale, then Director of the Mt. Wilson Observatory, and supported by Dr. J. C. Merriam, Director of the Carnegie Institution, made it possible to install the necessary apparatus on Mt. Wilson, with Mt. San Antonio, twenty-two miles away, as the distant station, during the summer of 1923; but smoke and haze from burning oil and from forest fires made it impossible even to test the feasibility of the method at so great a distance.

This feat was accomplished during the past summer with very promising results. The set-up of apparatus involved several important changes in the arrangement employed in previous investigations, the most important of which consisted in the substitution of an octagonal revolving mirror for the usual plane-parallel, together with the introduction of a system of reflectors which eliminated all direct and diffuse extraneous light. Finally, a simple method for returning the light from the distant station to the source was substituted for the plane mirror used for this purpose in previous work, and this equipment functioned so well that no readjustment was required during the entire two months of the work.

[1] Address delivered at the University of Pennsylvania on September 19, on the occasion of the observance of the centenary of the Franklin Institute. Reprinted from the Journal of the Institute for November 1924.

The advantage of the octagonal revolving mirror, in addition to the higher speed obtainable, lies in the possibility of receiving the return light on a succeeding face, thus eliminating the measurement of the angular deflexion of the returned beam; or rather, transferring this measurement to the construction of the octagon, the angles of which were tested and found to be equal, with an uncertainty of only one part in a million.

The determination of the velocity of light is thus reduced to the measurement of the distance between the stations, and of the speed of rotation of the mirror. The former operation was carried out by the U.S. Coast and Geodetic Survey, and the result obtained was 35,426·3 metres (about twenty-two miles), with an uncertainty of the order of only two parts in a million. The errors in the measurement of the speed of the revolving mirror were much greater, as no very effective means were employed to ensure its constancy. (This defect will be eliminated in the continuation of the work next summer.)

Notwithstanding the inconstancy of the speed of the mirror, the choice of the most favourable moment, when the speed was that corresponding to the frequency of a control tuning-fork, made the resulting uncertainty of the measurements of the order of one ten-thousandth part, which is about that of the mean of all the previous measurements. It is hoped that next year's work will furnish results four or five times more accurate.

The result of eight independent observations in the present preliminary work is, for the velocity of light *in vacuo*, 299,820 kilometres per second.

Following is a table of results of the more important investigations to date, with an estimate of the weight which should be assigned to each:

Investigator.	Method.	Distance.	Weight.	Velocity.
		km.		
Cornu	Toothed wheel	23	1	299,950
Perrotin	Toothed wheel	12	1	299,900
Michelson	Revolving mirror	0·6	2	299,895
Newcomb	Revolving mirror	6·5	3	299,860
Michelson	Revolving mirror	35·4	3	299,820

Obituary.

DR. FRANZ DOFLEIN.

IT seems but a short time since we deplored the premature death of Prof. Minchin, and now protozoologists have lost another distinguished leader, Prof. Doflein of Breslau, who died at the age of fifty-one on August 26. It is by his excellent text-book, "Lehrbuch der Protozoenkunde," that Doflein is most widely known. The fourth edition, which appeared in 1916, has been out of print for some years, and he had been working for the last three or more years on a fifth edition, although often interrupted by illness, aggravated by depression caused by the War. However, it is some satisfaction to learn that this new edition may be expected soon to appear, as it is being prepared for the press by Prof. Reichenow, of the Institute of Tropical Medicine in Hamburg.

Many in Great Britain will remember Prof. Doflein's charming personality and his readiness to help any one interested in his subject. He attended the Dundee Meeting of the British Association in 1912 and worked much at the Zoological Stations of Naples and Rovigno as well as in the Musée Océanographique at Monaco.

Franz Doflein was born in Paris in April 1873, his mother being of English origin and his father a German merchant. At seven years of age, on the death of his father, he was taken to Germany to be educated. In 1896 he went to the University of Munich to study medicine, but, coming under the influence of Prof.

Hertwig, he decided to devote himself to zoology. After graduating, several university posts were held by him in Munich until 1912, when he was appointed Weissman's successor as professor of zoology at Freiburg. Here he taught for six years, finally moving to Breslau in the autumn of 1918 to become Director of the Zoological Institute in succession to Kükenthal.

A many-sided naturalist, Doflein published work on crabs, ants and Bdellostoma as well as his numerous important papers on the protozoa. The first edition of his text-book appeared in 1901 under the title "Die Protozoen als Parasiten und Krankheitserreger." The second edition five years later was the first to be known as the "Lehrbuch der Protozoenkunde," and it included descriptions of free-living as well as parasitic protozoa. In collaboration with his friend Richard Hesse, Doflein recorded their observations on living animals in a popular book entitled "Tierbau und Tierleben," which appealed to a large circle of readers. In addition to this, he wrote popular books on three scientific expeditions undertaken by him—to the West Indies, Japan, and Macedonia. The last, on his Macedonian travels, published in 1921, is illustrated with his own water-colour sketches.

In the early part of 1923, owing to continued ill-health, Doflein resigned his appointment in Breslau, and he died of pneumonia on August 26, 1924. Thus was tragically cut short a life of great achievement, for not only did he contribute much to biology himself but he also attracted many students to his laboratories, where they were allowed to follow their own lines of research, although always sure of his help in difficulty. His liberality and broad-mindedness were indeed part of that artistic temperament which delighted all with whom he came in contact.

THE *Chemiker Zeitung* of November 4 records the death, on October 25, at the age of seventy-two, of Dr. Carl Huggenberg, one of the pioneers among German public analysts. Huggenberg's name is associated with the well-known Analytical Institute founded by him at Chemnitz, where most of his public work was carried out. Born of Swiss parentage at Winterthur, he studied first at Zurich and later at Würzburg, where he became assistant to J. Wislicenus, and graduated in 1876. During the following three years he held an official appointment as analyst of foodstuffs in the Canton of Zurich. This special branch of applied chemistry was still in its infancy at that time, but in all the German towns, associations were being formed with the object of fighting against the adulteration of food. In 1882, the association which had been founded five years previously at Chemnitz by L. Friedrich, offered Huggenberg the direction of its laboratory. Here he found full scope for the development of his natural powers. His analytical skill, his comprehensive knowledge of chemistry, and his practical insight into the needs of industry and commerce were invaluable assets to him, and his opinion on technical matters was soon widely sought. His interest in technology led him to make numerous valuable investigations in oils, fats, and soaps, and he made numerous contributions to scientific literature on the refractometry of soap-fats, the recovery of waste fat, and on soap analysis. Until 1902 he also held the post of food controller at Chemnitz. In 1910 he retired to Zurich.

Current Topics and Events

THE Fishery Board of Scotland recently issued a notice to fishermen and others directing attention to the protection afforded to the grey seal under the Grey Seals Protection Act of 1914, which lays open to a penalty of 5*l*. any person taking, killing, or wounding grey seals during a close season, October 1-December 15. The publication of the notice has led to correspondence in the Scottish newspapers, the protection of this seal being condemned on the ground that it is increasing in numbers and is responsible for the destruction of some of the Hebridean cod fisheries. The weight of the evidence, however, seems to indicate that the grey seal is very rapidly decreasing in numbers on the west coast, and that the constant slaughter of the young in certain breeding haunts, their pelts being sent in considerable numbers to furriers in Glasgow, threatens the existence of the species in these waters. As regards the destruction of fisheries, the assertion is made that dog-fish and not cod form the diet of the seal, and that the destruction of seals and consequent increase of dog-fishes are responsible for the deficiency of cod. The point is an important one, which is left undecided by the assertions of the correspondents. It might readily be settled by the examination, by an expert in fragmentary fish remains, of a few series of stomach contents taken at appropriate seasons.

THE Field Museum of Natural History, Chicago, has arranged a series of twelve free programmes of moving pictures, with occasional lectures, illustrating natural history subjects, for children on Saturday mornings from October to December. The subjects include "Wild Animals I have known," by Mr. Ernest Thompson Seton, Capt. Kleinschmidt's "Polar Adventure," Theodore Roosevelt's "Visit to a Bird Reservation," and a number of films illustrating particular facts and aspects of zoology, botany, and geology. At each entertainment a little printed "museum story" is given to each child. This story gives, in simple language, some brief facts about the men, animals, and plants seen in the pictures, and directs the child to the case or cases in the Museum in which they are exhibited. By directing attention to the permanent exhibits in this way, opportunity is afforded to the child to crystallise the general impressions and information gathered from the films, and the real educational value of the scheme is thereby enormously enhanced. It surely is more than a series of entertainments, as the programmes are described on the syllabus. The experiment will be watched with great interest not only by those who believe in the vast potentialities of museums in education, but also by those who are convinced of the possibilities of the cinematograph as an aid in the same field.