THE LATE MR. ARCHIBALD SMITH

MR. ARCHIBALD SMITH was born at Glasgow in 1813; his father, Mr. James Smith, of Jordanhill, Lanarkshire, was well known as a geologist, and as the author of a learned and critical work on the Voyage and Shipwreck of St. Paul.

At the University of Glasgow Mr. Smith was a contemporary of the late Norman McLeod and of the present Archbishop of Canterbury, with both of whom he retained a friendship through life.

From Glasgow he went to Trinity College, Cambridge, where, while still an undergraduate, he commenced to contribute papers to the Mathematical journals; his first, a most important paper "On the Equation to Fresnel's Wave Surface," is an excellent example of the extreme neatness and elegance of his style; it was published under the signature A. S. in the Cambridge Phil. Trans. and in the Phil. Magazine.

He, however, as the result well showed, did not allow his amateur mathematics to interfere with the regular course of Tripos reading, and he also found time for a good share of athletic exercise. He pulled in the Trinity boat of which the late Lord Justice Selwyn was stroke; all the oars in that boat were reading men, and were familiarly known as "Peacock's examples" (Peacock being a well-known tutor of the day). It was no doubt owing to Mr. Smith's strong physical constitution which was thus well trained in early life, that he was able so long to sustain the great strain of mental effort and the want of rest to which he never scrupled to subject himself in after years when occasion required.

In 1836 he finished his undergraduate's career by taking the first place in the mathematical tripos as well as the first Smith's prize, and he was soon after elected a Fellow of his College. The second wrangler of his year was Bishop Colenso.

Having chosen the profession of the Chancery Bar, Mr. Smith became a pupil and a friend of Mr. James Parker, afterwards Vice-Chancellor, and is said to have acquired the sound legal learning and careful method which distinguished that judge. It was during the intervals of his laborious Chancery practice that he found time for the long series of magnetic investigations which has made him famous throughout Europe.

His connection with Magnetic Science arose from intimacy with Sir Edward Sabine, the late distinguished president of the Royal Society, and who was interested in the question of the Deviation of the Compass, first as member of a committee appointed by the Admiralty to consider the question, and afterwards as having undertaken the reduction and publication of the magnetic observations made by Sir James Ross in his Antarctic voyage.

In the years 1842 to 1847 Mr. Smith, at General (then Colonel) Sabine's request, deduced from Poisson's general equations, formulæ for the correction of the observations made on board ship. These were published in successive numbers of Sabine's "Contributions to Terrestrial Magnetism," in the Transactions of the Royal Society.

In 1851, at the request of Captain Johnson, the superintendent of the Compass Department of the Royal Navy, he deduced from the formulæ the convenient tabular forms, and computed the auxiliary tables for determining the co-efficients A, B, C, D, E, which have ever since been in use. These were published by the Admiralty in successive editions, but without the demonstrations or formulæ.

In 1859 Mr. Archibald Smith edited and published the voyage of Scoresby to Australia, which was undertaken chiefly for magnetic research; and in his introduction gave, for the first time, the *exact* formulæ for the effect of the iron of a ship on the compass, the former approximate formulæ being found insufficient.

In 1862 he, conjointly with Captain Evans, the present chief of the Compass department, prepared the Admiralty Compass Manual, a book which has since been translated into French, German, Russian, and Portuguese, and gone through three editions. The work is divided into four parts, the first of which contains practical rules to enable a seaman by the process of swinging his ship to obtain a table of the deviations of the compass on each point, and then to apply the tabular corrections to the courses steered. The second part is a description of "Napier's graphic method," the practical advantages of which are that it enables the navigator from observations of deviations made on any number of courses, whether equi-distant or not, to construct a curve in which the errors of observation are as far as possible mutually compensated, and which gives him the deviation as well on the compass courses as on the correct magnetic courses. Part III. contains the practical application to this subject of mathematical formulæ derived from the fundamental equations deduced by Poisson from Coulomb's theory of magnetism. Prior to this time it was considered sufficient to use approximate formulæ, going as far only as terms involving the first powers of the co-efficients of deviation; but the very large deviations found in iron-plated ships of war rendered it desirable to use in certain cases the exact instead of the approximate formulæ, and this part was therefore re-written. The fourth part of the "Manual" contains charts of the lines of equal variation, equal dip, and equal horizontal force over the globe; the first for the purpose of enabling the navigator at sea to determine the deviation by astronomical observations, the two latter to throw light on the changes which the deviations undergo in a lengthened voyage, and to enable the navigator to anticipate the changes which will take place on a change of geographical position.

All Mr. Smith's investigations were undertaken as labours of love; but we must not leave unnoticed some of the recognitions which he received.

In the year 1865 one of the Royal medals of the Royal Society was awarded to him, and he was elected a corresponding member of the Naval Scientific Committee of Russia; in the following year the Emperor of Russia, with a most complimentary letter, presented him with a gold compass emblazoned with the Imperial arms, and set with brilliants.

Recently, too, our own Government offered him a present of 2,000*l*., and intimated the fact to him in a handsome letter from the First Lord of the Admiralty, begging his acceptance, not by way of recompense, but as a mark of the high appreciation which the Government had for the services he had rendered.

The history of Mr. Archibald Smith's legal life is soon told. He attained the reputation of being an eminently concise and perspicuous draughtsman, and made a practice at the bar which was above the average both in extent and importance.

When Sir James Parker was made Vice-Chancellor he appointed Mr. Smith his Secretary; but the early death of Sir James brought these duties to a close. Later, a Judgeship in Queensland was offered to him, which he declined. It is said that the important change which has substituted figures for words as to dates and sums occurring in bills in Chancery was made at the suggestion of Mr. Archibald Smith.

In 1868, when the Universities of Glasgow and Aberdeen were formed into a parliamentary constituency the liberal electors chose Mr. Smith as their candidate, and they did their best, though without avail, to bring him in for the new seat.

About two years ago he was compelled by ill-health to give up work; but he had greatly rallied; and the attack which ended fatally was totally unexpected, and of but a few hours' duration. In private life those who knew Mr. Smith best admired him most; he leaves unnumbered friends to testify to the noble simplicity of his disposition, and to the true warmth of his heart, which was always open amongst his multifarious and engrossing work.

NEW EXPERIMENTS FOR THE DETERMINATION OF THE VELOCITY OF LIGHT BY M. ALFRED CORNU

AN exact value of the velocity of light is equally interesting to astronomers and physicists. It is interesting to astronomers, for it enables us to calculate an important and not exactly known number, namely, the distance from the sun to the earth, for which cause the learned world is looking forward with so much impatience to the passage of Venus on the disc of the sun, as the observation of this phenomenon, it is hoped, will fill up this chasm. It is interesting to physicists likewise, it is evident, but especially since the remarkable researches* of Prof. Clerk-Maxwell, who has found an unexpected relation between the theories of light and electricity.

M. Alfred Cornu's experiments, to which we now call attention, have for these reasons a great interest.

The first who busied himself with this difficult question was Rœmer, a Dane, at the Observatory of Paris, where Picart had called him; but the observation of the eclipses of Jupiter's satellites, although giving a pretty good value of the velocity of light, offers, notwithstanding, some causes of error, especially the difference of brightness of Jupiter's satellites at their maximum or minimum distance from the earth; and it requires moreover an exact value of the diameter of the terrestrial orbit.

M. Fizeau (1849) showed that it was not necessary to employ astronomical phenomena, and that it was possible on the surface of the earth to make use of relatively short distances, such as four or five English miles. This rather bold experiment was much spoken of. He operated between Montmartre and Suresnes, near Paris, at a distance of about five English miles and a half.

Léon Foucault, some time after, putting into execution a project of Arago, proposed another method founded on the revolving mirror of Sir Ch. Wheatstone. The value obtained by him, 189,000 miles (298,000 kilometres) was made use of by astronomers, who deduced for the parallax of the sun a number (8″. 86), that is in concordance with the best observations of the transit of Venus.

The number obtained at first by M. Fizeau was higher, but it was given by him, who dwelt upon all the difficulties of such a measurement, with hesitation.

M. Alfred Cornu left aside Foucault's method (viz., that of the revolving mirror) which is liable to serious objections, and employed that of M. Fizeau, although he had tried the two methods of experiment at the Polytechnic School, where many physicists were able to see them.

M. Fizeau's method is free from all objection. A ray of light is sent between the teeth of a cog-wheel, and it is reflected at a great distance, so as to bring it back to the point of departure. If the revolving motion given to the wheel is sufficiently rapid, the ray on its way back meets a tooth, instead of a free passage, and does not pass through; when the speed is double, the ray meets the following interval, and passes through again, and so forth alternately for increasing rates of revolution.

Thus the returning ray alternately presents a minimum (or an extinction) and a maximum; but the speed of rotation (in order to be measured) must be kept constant during several seconds in those moments: it is one of the greatest difficulties of the experiment, for that speed is enormous. Let us add the want of precision in the evolution of a maximum or a minimum.

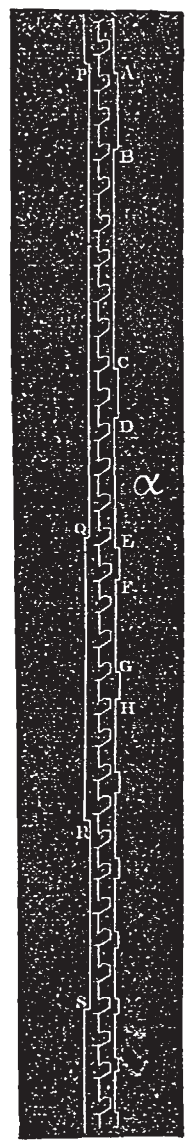
* Everyone knows that in one of the last meetings of the British Association Sir William Thomson has estimated them at their real value.

M. Alfred Cornu has obviated all those difficulties:—

1. By giving a speed of rotation not constant but increasing or decreasing according to a regular law, which he registers by means of electricity; so that he easily knows the speed at every moment.

2. By registering in the same manner the exact time in which the ray of light disappears and appears again: and thus he does not observe the instant of maximum or minimum, but two instants which are equally distant from the moment that is to be determined.

The various results are traced by fine needles that run on a sheet of paper covered with lamp-black, and rolled round a revolving cylinder. If the needles remain motionless, they describe a helix on the black paper, which becomes a straight line when the cylinder is unrolled. But these points are extremities of armatures of electro-magnets, and are moved when the electricity passes through; and during all the time the current passes, the traced line is above the level of the normal line.



Copy of the Automatic Registrations.

The annexed sketch shows a part of an experiment made in the month of July 1872.

The line a on the right hand side represents the increasing speed of the wheel; each time a cog of the apparatus, in its movement of rotation, touched a certain wire, the electric current had passed through, and deviated the needle for the time the cog was passing (from A to B, from C to D). During the time, from the beginning of one deviation to the other (from A to C, from C to E, from E to G), 50,000 teeth had passed. We clearly see that these intervals are decreasing, because the speed increases.

The median line indicates seconds which are sent by an electric clock.

The third line has been obtained by the observer himself by means of a Morse-key; he made the electric current pass during the time the light was invisible; P Q and R S. The sketch thus shows two extinctions and two reappearances of light. It is the beginning of the experiment.

This method, moreover, obviates one of the greatest difficulties in physical experiments, namely the noting down of various numbers, that diverts the observer and complicates operations. Furthermore, there remains not only the remembrance of the experiment made, but an exact, real, and living drawing.

M. A. Cornu has, moreover, changed the rather large and expensive apparatus of M. Froment for another,