and which appeared to have an enormous internal resistance, though its blue appearance and other indications pointed to rather a low vacuum, which seems to show that this is the case.

A. A. C. SWINTON.

66 Victoria Street, S.W., June 8.

Dalton's Atomic Theory.

WITH reference to the communications from the authors and from the reviewer of the "New View of the Origin of Dalton's Atomic Theory," published in NATURE for May 14, I beg leave to offer the following remarks. The most serious difficulty which the reviewer advances against the new view, seems to be that Dalton, in his manuscript lecture to the Royal Institution in 1810, states that, as a consequence of an idea respecting elastic fluids which occurred to him in 1805, "it became an object to determine the relative *sizes* and *weights*, together with the relative *number* of atoms in a given volume"; whereas in one of his note-books, under date September 6, 1803, a table of atomic weights is given. The reviewer says:—"The authors notice this conflict of statement, but get rid of it by assuming 1805 to be a clerical error for 1803." In regard to these conflicting dates, I beg to draw attention to a passage which appears to have escaped the vigilance both of the authors and of the reviewer, and which seems to tell strongly in favour of the clerical error theory. In the preface to Part I. of Dalton's "New System of Chemical Philosophy" (1808), the author, writing of himself, says:—"In 1803, he was gradually led to those primary laws, which seem to obtain in regard to heat, and to chemical combinations, and which it is the object of the present work to exhibit and elucidate. A brief outline of them was first publicly given the ensuing winter in a course of lectures on natural philosophy, at the Royal Institution in London, and was left for publication in the journals of the Institution; but he is not informed whether that was done." I do not think there is any room for reasonable doubt that this passage refers, amongst other things, to the same idea as that stated in the manuscript lecture to have occurred to Dalton in 1805. In any case the date 1803 is definitely settled by the sentence referring to the lectures at the Royal Institution, since we know that Dalton's lectures were begun there on December 22, 1803 (compare Roscoe and Harden's "New View, &c.," p. 61). It ought to be possible to place this matter beyond all doubt if the notes stated by Dalton to have been left for publication in the journals of the Royal Institution are forthcoming.

LEONARD DOBBIN.

University of Edinburgh, May 15.

Halley's Chart of Magnetic Declinations.

I AM again able to add another reference to the list of publications of Halley's Chart of Magnetic Declinations (see NATURE, vol. lii. pp. 79, 106, 343).

The chart to which I now refer is one of the plates of Peter van Musschenbroek's work, entitled "Physicae Experimentales et Geometricae de Magnete, Tuborum Capillarium Vitreorumque Speculorum Attractione, Magnitudine Terrae, Coliaerentia Corporum Firmorum"; Lugundi Batavorum, MDCCXXIX. Its size is $19\frac{1}{8}$ inches × $7\frac{3}{4}$ inches, and it takes in the entire circumference of the globe. The title, in the upper left-hand corner, reads: "Tabula Totius Orbis Terrarum Exhibens Declinationes Magneticas, ad Annum 1700. Composita ab Edmundo Halleyo. Simul eum Inclinationibus a Poundio Observatis."

CHAS. L. CLARKE.

New York, May 28.

Professorial Qualifications.

I AM anxious to prepare myself for the appointment of professor or teacher in chemistry at one of the new technical schools held under the County Councils. Will you kindly inform me the best way to become competent for the post? My age is twenty-five, and I hold first-class certificates in advanced chemistry at South Kensington Science and Art examinations. Is it necessary to obtain the F.I.C. or some similar degree first? Any hints you could give me would be of great help to me.

I must add that at present I have had no experience in teaching.

STUDENT.

LEAP-YEARS AND THEIR OCCASIONAL OMISSION.

AFTER the present year there will be no leap-year, at any rate, in the many countries which now observe the Gregorian style, until 1904; in other words 1900, which would, by the Julian rule, have been a leap-year, will be a common year and have to content itself, like the three years preceding and the three years following it, with the ordinary number of three hundred and sixty-five days. Only once has a similar omission occurred before since the reformation of the calendar in England, viz. in 1800, a year remarkable enough in other respects. The change was originally made in 1582; but as centuries divisible by four hundred without remainder were to be considered leap or bissextile years by either reckoning, there was only occasion, in 1700, when a year was observed as such in England, which was a common year in southern Europe; for 1600 was, as 2000 will be, a leap-year by the Gregorian as well as by the Julian reckoning. Few persons seem to recollect that the change which was effected at Rome in 1582, and followed in this country in 1752, was twofold in its character. If it be desired to make the date in any year correspond exactly with the season of the year, this can of course be done for any future time by inserting or omitting certain intercalary days in the calendar in some such way as is directed by the Gregorian rule to which we are now accustomed, and which was devised by Clavius under the authority of Pope Gregory XIII. But if this had not been done in past ages through want of exact knowledge of the true length of the year, or from any other cause, the fact may either be accepted as inevitable and therefore regretfully disregarded, or we may, if we wish, so change the existing dates in the year from which we start, as to make the seasons correspond with what they were on these dates at some definite period in the past. This is what was actually done, the period selected being A.D. 325, the year of the first great Council of the Church held at Nicæa in the reign of Constantine the Great. At that time the vernal equinox fell on March 21; and as, in consequence of the observance of the Julian length of the year in the interim, it fell in 1582 on the 11th of that month, it was decreed that in the following autumn ten days should be struck out of the calendar, by calling the day after October 4 the 15th, so that in future the vernal equinox (and all the other seasons) should fall as they had done in 325. This arrangement involved another inconvenience besides the awkward enumeration of days in that year, viz. that the seasons were made to disagree appreciably with their dates in the years and centuries immediately preceding the time of the change. However, on the whole, it was thought to be the best arrangement, and it was gradually followed by most of the nations of Europe excepting Russia. In England the change was made in 1752, and the calendar in all respects assimilated to that of the New Style, adopting the Gregorian rules. As in accordance with these, 1700 had not been a leap-year, whereas in England by the Julian reckoning it had been, the two calendars now differed by eleven days; the Act of Parliament therefore, which ordered the change, enacted that the day after September 2, 1752, should be called the 14th.

In speaking of the erroneous length of the year assumed in the Julian calendar, we used the expression "through want of knowledge of the true length of the year, or from any other cause." This was intended as a reference to the fact that, although the exact length of the year was not known in the time of Julius Cæsar, it was certainly known that it fell several minutes short of $365\frac{1}{4}$ days. But it seems that he thought this was sufficiently near for all practical purposes; and a distinguished American astronomer of our own day, in the light of all our modern improved knowledge, is of that opinion. "The change of calendar," says Prof. Newcomb, "met with much popular opposition, and it may hereafter be conceded that in this instance the common sense of the people was more nearly right than the wisdom of the learned. An additional complication was introduced into the reckoning of time without any other real object than that of making Easter come at the right time. As the end of the century approaches, the question of making 1900 a leap-year as usual, will no doubt be discussed, and it is possible that some concerted action may be taken on the part of leading nations looking to a return to the old mode of reckoning."[1] We are now several years nearer that time than when these words were written, but there is no proposition to return to the Julian reckoning, whilst it seems likely that Russia, which still observes it, will shortly adopt, either at once or by degrees, the Gregorian style, in which case all Christian nations will conform to its use. But it should never be forgotten that Cæsar's main object was to get rid of the previous Roman complication between a solar and a lunar year (endeavouring to keep them together by the insertion from time to time of an intercalary month), and substitute an entirely solar year with only an intercalary day every fourth year, making the length equal to its true amount within a few minutes.

But now comes the question, Is the so-called Gregorian year absolutely exact? Its length is unquestionably nearer that of the true typical year than the Julian year is. But a further modification is necessary if we really desire to make the date of the year correspond with the seasons for all time. The Gregorian rule amounts in fact to considering the year to contain 365·24250 days, whereas the typical year really consists of 365·24220 days, the difference being 0·00030 day, and the Gregorian year is too long by that amount. It in fact drops a leap-year not quite often enough, and a better rule would have been to drop one at the end of each successive period of 128 years. M. Auric has therefore recently suggested in the *Comptes rendus* of the French Academy a modification of the Gregorian rule, which would render it almost absolutely accurate, but which this generation need not, and in fact cannot, decide upon adopting. In 3200 years there are twenty-five periods of 128 years, so that there should be twenty-five omissions of leap-years. But by the Gregorian rule, only twenty-four leap-years are dropped in that interval, or one too few. His proposition then is to make an additional drop or omission of a leap-year in the year 3200 (which would, as the Gregorian rule now stands, be a leap-year), and at every succeeding period of 3200 years, A.D. 6400, 9600, being *not* leap-years. Strictly speaking, however, as the Gregorian calendar was arranged to start from A.D. 325, the first of these periods should expire more than three centuries later than A.D. 3200, and as A.D. 3500 will not be a leap-year by the Gregorian rule of dropping all divisible by 100 without remainder unless also divisible by 400, the nearest way to carry this proposal out practically would be to enact that A.D. 3600 should be an exception and not a leap-year; M. Auric's rule being afterwards applied at intervals of 3200 years, so that A.D. 6800 and A.D. 10000 would not be leap-years, although the Gregorian rule would make them so.

The present writer ventures to propound his own view that this same object would be carried out more straightforwardly by the natural course of dropping a leap-year at the end of each period of 128 years as it was completed, making unnecessary the Gregorian complication of an exception of an exception (*i.e.* the usual leap-year) now proposed to be increased by an exception of an exception of an exception. How exact this one exception would make the calendar (and M. Auric's suggestion would do precisely the same thing in a more roundabout way) may easily be shown. By dropping a leap-year (which usually occurs every fourth year) at the end of 128 years, we obtain in that period ninety-seven common years of 365 days, and thirty-one bissextile years of 366 days, or 46,751 days in all. Dividing this by 128, it is seen that this is equivalent to making each year contain 365·24219 days, the true length of the tropical year being (as above stated) 365·24220 days. It is agreed on all hands that 1900 is not to be a leap-year; and the effect of acting on this proposal would be that the next omission of a leap-year after that date would be in A.D. 2028.

W. T. LYNN.

[1] What Prof. Newcomb means here is making the vernal equinox which the paschal full moon followed, fall on the same date as it did at the time of the Nicæan council.

THE NICARAGUA CANAL.[1]

THE author of this book, though originally an engineer by profession, has become a traveller, a newspaper correspondent in Africa, the Far East, and Central America, and a writer about Eastern countries and problems. The book, accordingly, somewhat naturally reflects the two-fold experiences of the writer. Nicaragua is regarded, on the one hand, as the probable site of a gigantic engineering undertaking for connecting the Atlantic and Pacific, rivalling in commercial importance the Suez Canal; and the feasibility and prospects of the proposed canal are considered from an engineering standpoint, in combination with its commercial and political aspects, which cannot be disassociated from the more purely engineering problems involved. On the other hand, Nicaragua is described, in four chapters in the middle of the book, from the traveller's point of view; and details are given of the manners and customs of the population, the means of communication and resources of the country, with descriptions of the principal towns and other matters of interest noticed in the author's tour through the country. This portion of the book will possess attractions for readers of books of travel; but it appears to have been introduced rather with the object of recording the facts casually collected by the author, than as having any special bearing on the important problem of interoceanic communication. The main object of the book is unquestionably the Nicaragua Canal; and the Suez Canal has demonstrated that it is quite possible to construct a highway for navigation in a country devoid of natural resources, and that the physical conditions of the site selected, and the climate, are the main points which determine the feasibility of isthmian canals.

Several routes have been proposed for forming a water-way across the isthmus of Panama; but the only two which have been deemed capable of practical adoption are the line chosen for the Panama Canal, traversing a narrow portion of the isthmus between Colon and Panama, nearly following the course of the Panama Railway, and the more northerly Nicaragua route crossing a much wider part of the isthmus, in which, however, Lake Nicaragua provides a considerable length of natural water-way. The Paris Commission of 1879, presided over by M. de Lesseps, decided in favour of the Panama route in preference to all the others, including Nicaragua, mainly on the ground that it was essential that an inter-oceanic canal, with prospects of a very large traffic, should be an open water-way unimpeded by locks, like the Suez Canal; and Panama was the only route which could possibly fulfil this condition. When, however, owing to the treacherous nature of the soil under a tropical rainfall, the unhealthiness of the site when the surface vegetation was disturbed by the excavations, and the difficulties experienced in attempting to cope with the floods of the river Chagres, whose course frequently

[1] "The Key of the Pacific, the Nicaragua Canal." By A. R. Colquhoun. Pp. xiii + 443, with numerous illustrations, plans, and maps. (London: Archibald Constable and Co., 1895.)