advise them to adopt the fashion which is likely to please the examiners.

In thermodynamics we cannot easily adopt Mr. Muir's suggestion. Take the simplest case of unit quantity of mere fluid. v, p, t, E and ϕ are such that they are all known if any two (except in certain cases) are known. Any one *may* be expressed as a function of any other two. My symbol $\left(\frac{dE}{dv}\right)_p$ is quite definite. But to adopt Mr. Muir's suggestion I must say:—

Let $E = f\overline{v, p}$ then $\overset{1}{f}\overline{v, p}$ is what my symbol means. Inasmuch as my letters stand for the same quantities irrespective of the letters of which they are functions, I use one letter E where on Mr. Muir's suggestion I must use E as $f\overline{v, p}$ or $F\overline{v, t}$ or $\psi\overline{v, \phi}$ or $\chi\overline{p, t}$ or $\theta\overline{p, \phi}$ or $\xi\overline{t, \phi}$ or six distinct symbols if I have to express any differential coefficient of E, and if I have to express all the differential coefficients of v I must use other six symbols; altogether I must use thirty of these curious symbols instead of five common letters, and, furthermore, I must keep them all in my head. JOHN PERRY.

The First Magnetician.

WHILE thanking you and "R. T. G." for the exceedingly kind appreciation of the Gilbert Club's English translation of "De Magnete" (p. 249), I write to express the wish that the notice had mentioned the names of those who have collaborated in the production of this version. They are the late Mr. Latimer Clark, the late Sir B. W. Richardson, Rev. A. W. Howard, Prof. R. A. Sampson, Dr. Joseph Larmor, Sec. R.S., Prof. Meldola, F.R.S., Mr. Edward Little, Mr. G. T. Dickin and Rev. W. C. Howell. To the last-named a special recognition is due for indefatigable and critical care during the long final revision and press correction.

July 14. SILVANUS P. THOMPSON.

"Fox-shark" or "Thrasher" (Alopecias vulpes) in the English Channel.

ON July 2 a fine specimen of this shark was captured several miles south of the Eddystone Lighthouse by fishermen in search of mackerel. The fish was taken at a depth of about 40 fathoms, and did a large amount of damage to the mackerel nets before it could be hauled on board and killed. The shark was brought to the Plymouth Museum and purchased for the collection.

It may be worth while to state that the spiracles, which Couch says he was unable to detect, are distinctly visible in this specimen. It is scarcely surprising that they should be sometimes overlooked, for though our fish is 13 ft. (thirteen feet) 7 in. (seven inches) long (of which the tail occupies seven feet), the spiracles are only 1/12th (one-twelfth) of an inch long by 1/16th (one-sixteenth) of an inch wide. Each is situated exactly 2½ (two and a half) inches behind the eye, and a line from the spiracle to the tip of the snout passes just above the centre of the pupil. E. ERNEST LOWE.

Plymouth Museum, Plymouth.

THE TRAMWAYS EXHIBITION AT THE AGRICULTURAL HALL.

THE International Tramways and Light Railways Exhibition which came to an end on Saturday last must be regarded as having been very successful from all points of view. The opening ceremony was performed by Mr. Gerald Balfour on July 1, and was accompanied by the usual luncheon and speeches. Mr. Gerald Balfour alluded, as might have been expected, to the recent deputation to his Department on the subject of electrical legislation, but he did not evince any sign of having become convinced of the necessity for speedy reform. In other respects the speeches were not of much interest; the same may be said to be true to a certain extent of the proceedings of the International Tramways and Light Railways Congress, which held its meetings on July 1 and 2. The Congress, which was the twelfth held by the Union internationale permanente de Tramways, was the first to be held in London; the papers read and discussed dealt with the management and technical details of tramway schemes, and were most of them contributed by the engineers or managers of continental tramways. Many of them were very valuable, especially as they were based on the results of wide practical experience, but we doubt if they would prove of great interest to the readers of NATURE.

The exhibition itself contained a number of very attractive exhibits. Although primarily a general exhibition of all things pertaining to tramways, there was much on view which was of the greatest interest to those having nothing to do with traction. It was also very noticeable that the exhibition resolved itself practically into one of electric tramways. Of course, there was much that was not electrical—such, for example, as rails, points, &c.—but these are all part of the equipment of an electrical system. And perhaps the general impression with which one left the hall, that a "tramway" was necessarily the same thing as an "electric tramway," was of more interest, as a sign of the times, than were any of the individual exhibits.

Several different types of car were on view; the one which, not unnaturally, attracted the most attention was that constructed by Messrs. Dick, Kerr and Co. for the London County Council. This is the first of one hundred cars being built for the Council's South London Tramways. The car is double-decked, and has a total seating capacity of sixty-six (twenty-eight inside and thirty-eight outside), and is equipped for the conduit system to be used on the South London lines. The Westinghouse Company exhibited a car which ran over a fully equipped trolley line laid along the total length of the hall, a distance of more than 300 feet. Power was obtained for running this from a 75 kw. direct-current generator (500 volts), driven by a Westinghouse three-cylinder gas engine. The car was fitted with the Westinghouse magnetic brake. This brake has a triple action, acting as a wheel-brake, a track-brake and an axle-brake; it is energised by current derived from the car motors, which work as generators whilst the car slows down, the necessary energy being derived from the momentum of the car. The action of the brake is therefore independent of the main current supply.

A notable feature of the exhibition was the Bremer arc lamp, exhibited by the Westinghouse Company. This lamp was used for part of the lighting at the Natural History Museum on the occasion of the Institution of Electrical Engineers' conversazione. Unfortunately, it did not create a very favourable impression there, as the lamps kept flickering; those at the Agricultural Hall seemed to be burning much better. The carbons used in the Bremer lamp are saturated with certain minerals which volatilise and become incandescent in the arc; they are, moreover, arranged nearly parallel to one another instead of vertically one above the other; the ends project a little below a protecting hood, meeting at an angle of about 20°, and the arc is kept at the tips by means of a magnetic deflecting device. The position of the arc, the materials used in the composition of the carbons, and the reflecting power of the conical hood, combine to produce a highly efficient light. It is said that the lamp is three times as efficient as an ordinary arc. The colour of the light is also much pleasanter and warmer than that of the ordinary arc, and the light appears to fill the globe much better, with the result that it produces somewhat the effect of a golden ball of light.

Another similar arc lamp exhibited was that of the Union Electric Company. This, which is called the "Flame" arc lamp, has vertical carbons like an ordinary lamp; the carbons are, however, cored with a mixture of certain fluorides, and the upper one passes through a dome-shaped hood, which is fixed a little above the arc itself. A rather long arc is burnt, and the effect is very similar to that produced by the Bremer lamp, only the light is of a slightly different colour. This lamp is also said to be three times as efficient as an ordinary arc.

We have not space at our disposal to describe the exhibits fully. There is one other, however, which deserves special comment on account of its ingeniousness and possibly great importance. This is the Partridge "Sparklet" fuse, exhibited by Messrs. Elliott Brothers. This fuse is designed more especially for high-tension circuits carrying heavy currents. When the fuse in such a circuit goes an arc forms, and in order to prevent this burning, either a very long fuse or some form of oil fuse is used. In Mr. Partridge's "Sparklet" fuse a short length only is used, and the terminals of the fuse wire are connected to an ordinary sparklet such as is now a familiar article for making soda-water. The arc when it forms burns between the two sparklets, and in a very few seconds one or other of these is burnt through; the carbon dioxide immediately rushes out through the hole and blows out the arc. It will readily be understood that the more current the circuit is carrying, and the more power there is in the arc, the sooner will the sparklet burn through, and also the hole being larger the more certain it will be in its action. At the Agricultural Hall a model fuse was shown working a circuit of 2500 volts. The current was small, only about 6 amperes, the power being therefore about 15 kilowatts; yet the arc was blown out in less than three seconds. Two sparklets are used, one at each end of the fuse, in case one should be defective; but this precaution has never been found necessary during all the experiments and trials that have been carried out. For the past eighteen months the apparatus has been in practical use, and has proved, it is said, thoroughly satisfactory. Mr. Partridge is certainly to be congratulated on a very ingenious idea; it remains to be seen whether it will prove a sufficient cure for all the troubles that are likely to be met with now that large-power high-tension circuits are becoming common. M. S.

THE ASTROGRAPHIC CHART.

IT is probably well known, even to those who are not astronomers, that an astronomical enterprise of considerable magnitude was initiated fifteen years ago, and is steadily, although somewhat slowly, progressing towards completion. In the year 1887 a conference of astronomers met at Paris to consider the best means of cooperating to make a complete map of the heavens on a large scale, and with all possible attention to accuracy, by photography. As the outcome of this conference, eighteen observatories of various nationalities undertook the work, the whole sky being divided up into eighteen zones; a zone assigned to each observatory with due regard to its geographical position. A standard pattern of photographic telescope was chosen, and all the eighteen observatories obtained instruments of the required type and set to work. The enterprise being in several respects entirely new, it has been necessary to guide the procedure in the light of experience acquired; and conferences assembled at Paris in the years 1889, 1891, 1896 and 1900 to report progress and compare notes. At the last of these conferences a second enterprise was undertaken. The small planet Eros, discovered in 1898, was to make a particularly close approach to the earth in the winter of 1900–1, thus affording an opportunity, the like of which would not recur for thirty years, of determining the solar parallax; it was felt that, although the main object of the association of observatories (viz. the formation of the Astrographic Chart) was not yet attained, still the advantages to astronomy which would result from utilising this exceptional opportunity were too great to be neglected, and it was resolved that the cooperating observatories should add to their programme the photographic observation of the little planet during the months October 1900 to February or March 1901. In connection with this second enterprise it has been found necessary to circulate a large amount of statistical material, such as approximate positions of the planet on different dates and of all the well-known stars lying near his path in the heavens, lists of the observations made at the different observatories, so that one might know how to match plates with another, and so on. The energy of the director of the Paris Observatory (who has from the first acted as director of the whole work) in printing and circulating this material has been most noteworthy. We have recently received the *ninth* circular relating to Eros, which is itself a pamphlet of 200 pages quarto, and represents a vast amount of work. In the first place, M. Lœwy discusses, in two long memoirs (supplementing a former one already published), what accuracy is obtainable from measures of photographic plates and what precautions are necessary to obtain that accuracy. The discussion is concerned with a number of minute details, and involves the adjustment of conflicting advantages, so that there is room for difference of opinion in the conclusions; but there can be but one opinion of the value of the material patiently collected and tabulated by M. Lœwy, which can be examined in the light of any hypothesis preferred. The second part of the ninth circular gives, among other useful information, ephemerides of the planet Eros and of the sun, calculated to eight significant figures for every six hours—almost a new departure in such work, the only precedent being afforded by the investigations of Sir David Gill on the planets Victoria, Iris and Sappho, whereby he clearly showed that eight figures were necessary to represent the accuracy of heliometer measures. To advance one decimal place is of course a step of the gravest importance, and to Mr. Hinks, of the Cambridge Observatory, belongs the credit of being the first to show that an accuracy can be obtained from photographic measures of the Eros plates of the same order as that which led Sir David Gill to ask for an eight-figure ephemeris.

The appearance of so much important literature in connection with this second enterprise, the photographic observation of the planet Eros, naturally suggests a glance at the state of affairs with regard to the main work, the Astrographic Chart itself. It is, as remarked in the first sentence of this article, some fifteen years since the work was initiated, and it should by this time be possible to form an estimate of the probable outcome and the approximate date of completion. It must be confessed that the original estimate of the time required has already been seriously exceeded. In the letter which summoned the conference of 1887 it is stated that:—

"Ce grand travail . . . pourrait être facilement exécuté en quelques années si dix ou douze observatoires bien répartis sur le globe pouvaient se partager convenablement la tâche."

The phrase "quelques années" is somewhat indefinite, but it may be assumed that those who assembled in 1887 would have been shocked to learn that after a lapse of a dozen years scarcely one-fifth of the work projected had been accomplished. Indeed, many who are tolerably familiar with the general course of events may be startled to hear this statement made; and yet a glance at the last comprehensive report available (see R.A.S. *Monthly Notices*, vol. lxi. p. 280) shows it to be only too true. It was decided to work on such a scale that 11,000 plates would be required to cover the sky, and this number was to be repeated four times, twice with short exposures (of 6 minutes, 3 minutes and 20 seconds), and twice with long exposures (40 minutes). The plates of the first series (catalogue plates) were to be measured, and the measures printed and published; those of the second series