translated into intelligible form the various terms of one of the less formidable formulæ of Mr. Heaviside's memoir, I was surprized to find two old and very unpretending friends masquerading in one person like a pantomime Blunderbore. In one of his Avatars the monster contains, besides the enclosing brackets, no fewer than 24 letters, 12 suffixes, 3 points, and 5 signs! When he next appears he has still the brackets to hold him together, but although he has now only 18 letters, he makes up his full tale of 44 (or 46) symbols; for he has 9 suffixes, 3 indices, 3 points, 5 signs, and 3 *pairs* of parentheses! I used to know him as compounded of 14 separate marks only, viz.:— $V^2\nabla\sigma + 2S\nabla\nabla_1 S\sigma\sigma_1$:—but, unless I had required to dissect him, I should never have put him in anything resembling his new guise.

Dr. Knott's paper is, throughout, interesting and instructive:—it is a complete exposure of the pretensions and defects of the (so-called) Vector Systems. "Wer diesen Schleier hebt soll Wahrheit schauen!" I find it difficult to decide whether the impression its revelations have left on me is that of mere amused disappointment, or of mingled astonishment and pity.

P. G. TAIT.

Edinburgh, 24/12/92.

Measurement of Distances of Binary Stars.

WITH reference to Mr. C. E. Stromeyer's letter on the above subject, which appeared on p. 199, it may be of interest to point out that his plan of determining the distance of a binary star is by no means a new one.

The method was, I think, first suggested by Mr. Fox Talbot at the Edinburgh meeting of the British Association in 1871; but the mere idea was sufficiently obvious as soon as the possibility of determining velocities by the spectroscope had been demonstrated by Dr. Huggins.

The first discussion of the geometrical conditions of the problem was given by Prof. G. Niven in the *Monthly Notices*, vol. xxxiv. No. 7, where he exhibits the relation connecting the parallax, the relative velocity, and the elements of the orbit of a double star, and computes the value of the product (πV) of the parallax and velocity for a small number of binary systems.

In a paper published in the Proceedings of the Royal Irish Academy for May, 1886, I examined the same question from a slightly different point of view, being at the time unaware of Prof. Niven's paper, and was led to similar results. An epitome of this paper was published in your Astronomical Column, vol. xxxiv. p. 206. From the results obtained it appeared that, all things considered, γ-Coronæ Australis and α-Centauri were the most likely binaries to yield to this method of eliciting the secret of their parallax, while α-Geminorum, one of the stars selected by Mr. Stromeyer, was shown to be most unfavourable on account of the situation of its orbit.

In the *Monthly Notices* for March, 1890, I again drew attention to the subject in view of the accuracy of the results obtained by the photographic method in the hands of Prof. Pickering and Prof. Vogel. In this paper I gave an extended list of binaries with the usual geometrical and dynamical elements, and in addition the two elements A and B on which the relative velocity depends. I also gave the greatest value which πV can attain in each case and the velocity to be expected in the case of those stars whose parallaxes had been determined.

Again in Mr. J. E. Gore's valuable catalogue of Binary Star Orbits, published in the Proceedings of the Royal Irish Academy for June, 1890, columns 18 and 19 are devoted to the constants A and B computed from my formulæ (which I may say ought more properly to be called Prof. Niven's formulæ on account of the priority of his paper) for eighty-one different orbits.

The subject has also been discussed by Miss Clerke in "The System of the Stars," pp. 199–201, where references to most of the original publications will be found.

I may perhaps add that the inverse problem of determining the elements of the orbit from spectroscopic observations alone has also been investigated by me in the *Monthly Notices*, vol. li. No. 5, where I have deduced the principal elements of the orbit of β Aurigæ, a spectroscopic double which no telescope can divide.

I have been disappointed that astronomers engaged on spectroscopic determinations of stellar velocities have not devoted more attention to observations of already known binaries, which appear to me to offer a promising field of work, and have often regretted that at this observatory we have not the means of undertaking the investigation, and if Mr. Stromeyer's letter has no other effect than to bring the subject once more forward it will have done good service, but I should like to point out that the second of the stars selected by him ought on no account to be taken as a test of the feasibility of the method, since the accurate discussion of the conditions shows that unless this is an exceptionally remote system the velocity must be very small indeed. For instance, assuming Johnson's parallax, viz. 0″·20, the relative velocity of the components amounted last year to only 0·6 miles per second.

In the northern hemisphere the most favourably situated binaries are 70 Ophiuchi, ξ-Ursæ Majoris, and, if Peters' orbit represents the real motion of the pair, 61 Cygni; while for the southern hemisphere special attention ought to be directed to α-Centauri and γ-Coronæ Australis.

In Mr. Gore's Catalogue, referred to above, will be found all the materials for determining when to observe any known binary most favourably in this respect, and for deducing its parallax from the measures obtained, and it ought to be borne in mind before letting the subject sink back once more into oblivion, that, other things being equal, this method is most likely to succeed in the case of the most distant systems, where the parallax is so small that the ordinary trigonometrical method necessarily fails us, and that when the micrometer, the heliometer, and the stellar photograph break down, the spectroscope will sound the further depths with ever-increasing facility.

Dunsink Observatory, co. Dublin. ARTHUR A. RAMBAUT.
December 30.

December Meteors (Geminids).

THESE meteors were moderately abundant on the night of December 12, which appears to have been a very favourable one in regard to weather. The chief radiant point was observed in the normal position very close to α Geminorum, and there was a strong contemporary shower from a centre east of β Geminorum.

At 10h. 10m. December 12, a fireball estimated to be twice as brilliant as Venus was observed by Mr. Booth at Leeds. It moved rather slowly from 150°+43° to 188°+41°, and divided into two pieces at the finish.

Mr. Wm. Burrows, of Small Lane, Ormskirk, writes to me with reference to a meteorite which he observed to fall at a later hour on the same night. He says the time was 6.52 a.m. (December 13), and refers to the phenomenon as follows:—"Seeing the meteor was coming to the earth I crossed the road to where it appeared to be falling, and it fell about two yards from me. When it struck the earth it made a noise like the report of a gun; it also went black instantly. While descending it had a tail of fire about a foot long. It is 1⅜ inch in diameter one way, and 1¼ inch another, and one inch thick."

Mr. Burrows sends drawings of the object, and it being still in his possession it is hoped the matter may be suitably investigated. Should it prove a veritable meteorite one interesting circumstance in connection with it will be that its descent took place concurrently with the shower of Geminids.

It is significant that December 9–13 constitutes a well-defined æroliic epoch, rendered memorable by the fall at Wold Cottage, Thwing, Yorkshire, on December 13, 1795, and by many others, such as that at Mässing, Bavaria, December 13, 1803, at Weston, Connecticut, U.S.A., December 14, 1807; at Wiborg, Finland, December 13, 1813; at Ausson, France, December 9, 1858; at Baudong, Java, December 10, 1871, &c.

Bristol, January 1. W. F. DENNING.

The Earth's Age.

AS Dr. Wallace (NATURE, p. 175) trusts "that on further consideration" I shall "admit that" my "objection is invalid," it is evident that I have failed to make clear to him my argument showing that his data do not warrant his conclusion.

He overlooks the fact that a thickness of 177,200 feet of sedimentary rocks is, standing alone, a perfectly indefinite quantity; to make it definite it must have a definite area.

As he mentions no area for it we are justified in assuming that he means the land area of the globe, whereas his calculation is made as though area were not of the essence of the problem, in short, as if the formation of a pile of sediment 177,200 feet thick, of no matter what area, were the problem.