LETTERS TO THE EDITOR.

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On the Meaning of Symbols in Applied Algebra.

REFERRING as briefly as possible to Prof. McAulay's letter on page 588, I contend (1) that no complex reasoning is necessary to show that the commutative and associative laws hold for the symbols of units or (better term) standards; a simple method was indicated in vol. xxxviii. p. 281; and (2) that meaningless things like the square root of a foot do not appear in any correct final result. It is true that the square of an hour is meaningless too, but the *apparent* occurrence of such a thing, in acceleration for instance, is otherwise explicable; for velocity is a real and simple physical quantity.

Magnetic intensity is not really the time rate of the square root of a linear density, as Prof. McAulay imagines that physicists suppose it to be; he has omitted an essential factor; and when we discover the real nature of μ , we shall find it such as to satisfactorily rationalise the gibberish he properly "abhors." If, for instance, μ turns out to be an ethereal density, the specification of H would be length divided by time.

University College, Liverpool, OLIVER J. LODGE.
October 22.

Strange Instinct of Fear in the Orang.

THE following circumstance which occurred at the Zoo on Sunday last, and was witnessed by Mr. W. E. de Winton and myself, is perhaps worth putting on record.

We were watching and making friends with the baby orang, and my wife was standing by, holding on her hand a muff manufactured out of the skin of the Indian flying-squirrel, with the unstuffed skin of the head to the front, and the bushy tail hanging loosely over it. Suddenly, but quite gently, she stretched out the muff towards the orang, but at the sight of the advancing fur a light of unmistakable terror sprang into the creature's eyes. Upon repeating the experiment, the ape promptly rolled over backwards as the quickest way of removing himself from the immediate vicinity of the terrifying object; then gathering himself together, climbed up the branches of his tree, and retreated to the back of the cage, keeping all the while a wary and frightened eye upon the muff, as if in fear of an attack from behind. It is interesting that the whole performance was carried through without the utterance of a sound on the part of the orang; but that he was acting under the influence of fear, there is, I am persuaded, no doubt. His behaviour, in fact, reminded me irresistibly of the behaviour of a friend's little child of ten months old, who evinced similar signs of fright upon being shown a toy fur monkey for the first time.

R. I. POCCOCK.

Natural History Museum, October 25.

Hereditary Colour in Horses.

MR. FRANCIS GALTON'S very characteristic article in the current number of NATURE, page 598, upon hereditary colour in horses, appealed to me with more than usual interest, as for some months I have been planning a somewhat extensive investigation into the hereditary transmission of various characteristics amongst the higher members of the animal kingdom, including that of colour in horses.

It may be of interest to your readers if I summarise a recent quite preliminary investigation upon the same matter, which I shall hope at some future time to work out more thoroughly. I may add that, contrary to what Mr. Galton experienced with the data he used, all the grey foals in my data did *not* come from grey dams.

An examination of the offspring, numbering in all 1566, of one special class of mares shows that there were 686 offspring which resembled the general colour of the dam, and 880 which differed; or a preponderance of 28 per cent. dissimilar. Of these:—

313	colts	were	the	same	in	general	colour	as	the	dam.
394	"	"	"	not	"	"	"	"	"	"
373	fillies	"	"	the	same	"	"	"	"	"
486	"	"	"	not	"	"	"	"	"	"

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Hence we have two broad results: (1) the excessive preponderance of fillies over colts; and (2) that the colts more frequently resemble the colour of the dam than do the fillies. For every hundred fillies there would be 102 colts resembling the dam.

Truly this is not a large difference, but, based as it is upon over 1500 cases accurately described and exactly tabulated, it seems worth calling attention to, as it carries Mr. Galton's analysis a step further, and points to the possibility of a further development in an exceedingly interesting branch of heredity.

Churchfield, Edgbaston.

F. HOWARD COLLINS.

Dog Running on Two Legs.

IT is not necessary that a dog should be compelled by accident to resort to this mode of progression (p. 588). Some years ago I had a clever little Scotch terrier which would occasionally run in this way. It would balance itself on two legs, sometimes on one side and sometimes on the other, holding the other pair up, and run with perfect ease for a considerable distance. As this is the only instance I ever met with, or heard of, I do not suppose that the accomplishment is a common one with dogs.

Highfield, Gainsborough.

F. M. BURTON.

THE OBSERVATION OF METEORS, WITH ESPECIAL REFERENCE TO THE LEONIDS.

DURING the next few years a large amount of attention will be given to meteoric astronomy in general and to the great shower of Leonids in particular. The present may, therefore, be an appropriate time to refer to a few points connected with this interesting branch. It has often occurred to the writer that it would greatly facilitate the comparison of different materials if observers adopted one uniform method of recording meteor-flights. Some merely give estimated compass bearings, and a rough guess at the altitude and inclination of path, others give the place and direction according to conspicuous stars near, others simply mark the courses on a map without reading off the individual positions, while others give the R.A. and Decl. of both beginning and ending of every object observed. It would be a great advantage if every one tabulated results according to the latter method. It can easily be done if the tracks, as observed, are pencilled upon a celestial globe or star chart, and the positions read off; and this is a much more exact method than describing the flights by stars near which they happen to pass.

Another point is that the accurate observation of meteors demands a considerable amount of practice. It would, therefore, be a most useful preparation for intending observers of the Leonids if they carefully watched the Perseids of August, Orionids of October, and some other prominent displays, and gained a little practical experience of the work. They would find it of material assistance to them, and would enable the Leonids to be observed more expeditiously and correctly than must otherwise be the case. Accounts are sometimes published of meteoric showers by persons who are reporting a perfectly novel experience, and it is not too much to say that such descriptions are useless as regards many essential details. A perfect novice may of course stand and count the number of meteors visible, and may be capable of describing a star-shower in a general way, but he is heavily handicapped when it comes to recording the more difficult features with precision.

What photography may achieve in meteoric work we can not definitely foresee, but it is quite certain that the proper observation of meteors, as at present conducted, demands the work of a lifetime. A man must watch for meteors all night, and suitably record them, and by day he must analyse the observations and determine the radiant points. The observer need not, perhaps, absolutely isolate himself from all other work; but the meteoric

branch is such an extremely difficult one, embracing, as it does, some thousands of streams which exhibit many different peculiarities, that in order to grapple with the subject successfully he must make it his constant care and the object of his earnest efforts and thoughts during many years.

Fortunately the Leonids are to be classed amongst that description of meteors comparatively easy to observe and record. They leave streaks for a second or two, and from these the directions are to be determined with great facility and precision. It is also a fortunate circumstance that the radiant point is surrounded by the well-known stars in the Sickle of Leo. The lines of flight may therefore be readily carried back in the correct directions by projecting a straight wand upon the streaks, and noting their points of convergence relatively to the stars named.

The writer has usually found the radiant very definitely and sharply defined, and it can be readily fixed to within 2° of probable error. But naked-eye observation is capable of much more accurate results than this, if, during a pretty active return of the shower, the observer will independently fix the radiant during, say, successive half-hours of the night; he will in this way get eight, ten, or twelve positions, from which he may derive the mean place of the radiant to within about $\frac{1}{4}^\circ$ of error.

The Leonid radiant is sometimes described as very diffuse; but this is a false effect brought about by two circumstances which, if properly allowed for, would leave a very definite and satisfactory position. One cause of its apparent diffusion is that meteors are attributed to it which really belong to the minor showers in Leo and the surrounding region, of which quite a large number exist. They display similar visible characteristics to the Leonids, and can only be dissociated from them by the exercise of extreme care in noting their directions of flight. In *Popular Astronomy*, vol. i. p. 298, I gave a list of sixty-eight meteoric radiants situated in various parts of the heavens, and active during the period November 10-15; and in *The Observatory*, vol. xx. p. 306, a table of seventy-two circum-Leonid showers was published. Those which chiefly affect the determination of the Leonid radiant are placed near δ and ϵ Cancri, μ and ξ Ursæ Majoris, λ Hydræ and π , λ , τ and β Leonis. The meteors are swift, and usually leave streaks. Another contributing feature to dispersed radiation is found in the unavoidable errors of observation. Great care and habitual practice can, however, reduce these to small limits, and it will be found that the radiants derived from accurate materials will be pretty sharply defined.

The probable error in the case of different observers must, however, vary to a considerable degree, for practice cannot equally eliminate inaccuracy from amongst them all. In catching and retaining correct impressions of meteor flights, natural aptitude exercises an important influence. It is like a game of skill depending upon the eye, judgment and quickness in execution. Really few will excel, while many will only attain mediocrity, and some must altogether fail to acquire the desirable proficiency, even after years of experience.

The horary rate of appearance of Leonids cannot be exactly determined unless the contemporary showers are considered, and their meteors separated from the true Leonids. Many observers count every meteor proceeding from the general direction of Leo as necessarily a Leonid, and thus the horary number is exaggerated. If an inexperienced observer gives 20 as the number of Leonids seen in an hour, the fair inference is that not more than 14 or 15 of them were true members of that system. During very strong returns of the shower this point may, however, be disregarded, for the minor streams can then exercise very little relative influence on the results, and are virtually obliterated by the superabundance of Leonids.

One new feature to be attempted during the ensuing

return of the Leonids is to photograph the meteor group of November 1866 in space, and an excellent ephemeris of its nearly stationary position in Libra and south-eastern limits of Virgo, during the first four months of 1897, was given in *Monthly Notices*, lvii. p. 70-2. Some people will regard the idea as little more feasible than opening a correspondence with the inhabitants of Mars, and certainly there appears very slender prospect of its successful realisation. The experiment ought, however, to be tried. Let us support every project which has a possible side to it, for it is quite clear that many things deemed beyond our reach are capable of attainment by persevering efforts and proper means. Novel attempts of this kind, if seemingly chimerical, should not be hastily condemned or necessarily considered as vain labour. Mr. Roberts's photographic search for a trans-Neptunian planet was a novelty, and it proved vain labour; but who will say that it ought not to have been undertaken? The same may be said of Mr. Barnard's similar search for a satellite to the moon. To look for a fifth satellite of Jupiter was decidedly a novelty in these modern times, and yet it proved productive. Let, then, new researches like these have our encouragement; for if they do not always succeed, they stimulate our interest and enthusiasm, and make the science more attractive by imparting to it a welcome freshness and, perhaps, a touch of romance.

As to the practical aspect of the question, it is fair to conclude that the Leonid group of 1866 is too faint an object to be ever impressed on a photographic plate, especially when its distance is so great as during the past spring, for on March 1 this was equivalent to 800,000,000 miles, and not far short of the mean distance of Saturn! In the great meteor storm of November 27, 1885, when the meteors were more thickly congregated than in the Leonid shower of November 13, 1866, Prof. Newton computed that "the space in the meteoroid group corresponding to each single visible meteor was in the densest portion of the group, a cube whose edge is $32\frac{1}{8}$ kilometres or $20\frac{1}{4}$ miles." This means one small pebble in twenty miles of space! The degree of illuminating power exhibited by a group of these bodies, separated by such distances, must be infinitesimally small. If any one were to attempt to photograph Tempel's comet (1866 I.), on its return journey, the chances of success would be far greater, for though the comet has still to run eighteen months before reaching perihelion, it is nearer to us than the meteor group of 1866, and must be infinitely brighter, as it doubtless represents the richest part of the stream. We must remember that Tempel's comet passed its perihelion on January 11, 1866, while the meteor-group reached it ten months afterwards; and it is quite fair to suppose that the meteoric train of the comet, at a distance of some hundreds of millions of miles from the nucleus, must be relatively tenuous as compared with that part in the immediate wake of the comet. The meteors may not, however, show a regular decrease in numbers according to distance from their derivative comet, but may probably consist of a series of groups. There is every reason to believe that disruptions of a violent character affect the physical character of comets, and this was well exemplified in Brooks's comet (1889 V.), visible, in 1896, at its second observed return, which was seen separated into five portions on August 1, 1889. There is, however, every probability that the meteor cluster of 1866 is some hundreds of times fainter than Tempel's comet; yet even the latter was not visible to the naked eye in December 1865, or January 1866, and indeed the object was only followed for a month in telescopes. It might be a good plan to endeavour to photograph the comet first, and then fish for its associated meteor-stream; for the easier objects are sometimes capable of leading us up to the discovery of the more difficult ones.

W. F. DENNING.