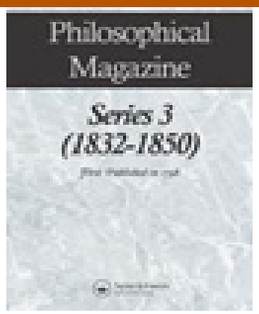

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XLVIII. On shooting stars

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that there was no more occasion to notice *explicitly* the light coming from the wires, than there would have been if the earth had really been at rest. While, however, I would vindicate my explanation from any flaw or deficiency of reasoning (unless the not noticing formally and explicitly the light coming from the wires be regarded as such), I allow that, without investigation, I fancied the path of a ray in space to be curvilinear. It was first virtually proved by Professor Challis, though not explicitly stated, that the path was rectilinear throughout. Consequently the angle *peq* (Phil. Mag., vol. xxvii. p. 14), which I argued was insensible, is in fact zero. The method which consists in considering the rectilinear propagation of light as resulting from the supposition that $udx + \ldots$ is an exact differential, and then the law of aberration as resulting from the rectilinear propagation, instead of considering the whole at once, has the advantage of showing that we are at liberty to suppose the velocity of the æther at the surface of the earth to be of any amount relatively to the surface. I had not contemplated this case; for it was the precise object of my investigation to get rid of the apparent necessity of supposing the æther to be rushing through the air and through the earth itself as the earth moves round the sun.

XLVIII. *On Shooting Stars. By* J. P. Joule, *Corresponding Member of the Royal Academy of Sciences, Turin, Secretary to the Literary and Philosophical Society, Manchester**.

I HAVE read with much interest the valuable papers on shooting stars inserted by Sir J. W. Lubbock in the Numbers of the Philosophical Magazine for February and March. This philosopher seems to have placed the subject in a fair way for satisfactory solution. He has advanced three hypotheses to account for the sudden disappearance of these bodies, the last of which he has enabled us to prove or disprove by actual observation.

I have for a long time entertained an hypothesis with respect to shooting stars, similar to that advocated by Chladni to account for meteoric stones, and have reckoned the *ignition* of these miniature planetary bodies by their violent collision with our atmosphere, to be a remarkable illustration of the doctrine of the equivalency of heat to mechanical power or *vis viva*. In a popular lecture delivered in Manchester on the 28th of April 1847, I said, "You have, no doubt, frequently observed what are called *shooting stars*, as they appear to emerge from the

* Communicated by the Author.

dark sky of night, pursue a short and rapid course, burst, and are dissipated in shining fragments. From the velocity with which these bodies travel, there can be little doubt that they are small planets which, in the course of their revolution round the sun, are attracted and drawn to the earth. Reflect for a moment on the consequences which would ensue, if a hard meteoric stone were to strike the room in which we are assembled with a velocity sixty times as great as that of a cannon-ball. The dire effects of such a collision are effectually prevented by the atmosphere surrounding our globe, by which the velocity of the meteoric stone is checked, and its living force converted into heat, which at last becomes so intense as to melt the body and dissipate it in fragments too small probably to be noticed in their fall to the ground. Hence it is, that although multitudes of shooting stars appear every night, few meteoric stones have been found, those few corroborating the truth of our hypothesis by the marks of intense heat which they bear on their surfaces*."

The likelihood of the above hypothesis will be rendered evident, if we suppose a meteoric stone, of the size of a six-inch cube, to enter our atmosphere at the rate of eighteen miles per second of time, the atmosphere being $\frac{1}{100}$dth of its density at the earth's surface. The resistance offered to the motion of the stone will in this case be at least 51,600 lbs.; and if the stone traverse twenty miles with this amount of resistance, sufficient heat will thereby be developed to give 1° Fahrenheit to 6,967,980 lbs. of water. Of course by far the largest portion of this heat will be given to the displaced air, every particle of which will sustain the shock, whilst only the surface of the stone will be in violent collision with the atmosphere. Hence the stone may be considered as placed in a blast of intensely heated air, the heat being communicated from the surface to the centre by conduction. Only a small portion of the heat evolved will therefore be received by the stone; but if we estimate it at only $\frac{1}{100}$dth, it will still be equal to 1° Fahrenheit per 69,679 lbs. of water, a quantity quite equal to the melting and dissipation of any materials of which it may be composed.

The dissolution of the stone will also be accelerated in most cases by its breaking into pieces, in consequence of the unequal resistance experienced by different parts of its surface, especially after its cohesion has been partially overcome by heat.

It appears to me that the varied phænomena of meteoric stones and shooting stars may all be explained in the above

* Manchester Courier newspaper, May 12, 1847.

manner; and that the different velocities of the meteorolites, varying from four to forty miles per second according to the direction of their motions with respect to the earth, along with their various sizes, will suffice to show why some of these bodies are destroyed the instant they arrive in our atmosphere, and why others, with diminished velocity, arrive at the earth's surface.

I cannot but be filled with admiration and gratitude for the wonderful provision thus made by the Author of nature for the protection of his creatures. Were it not for the atmosphere which covers us with a shield, impenetrable in proportion to the violence which it is called upon to resist, we should be continually exposed to a bombardment of the most fatal and irresistible character. To say nothing of the larger stones, no ordinary buildings could afford shelter from very small particles striking at the velocity of eighteen miles per second. Even dust flying at such a velocity would kill any animal exposed to it.

XLIX. *Analysis of the Theory of Equations, with a few Remarks on recent English Works on the subject. By* James Cockle, *Esq., M.A., Barrister-at-Law. In a Letter to* T. S. Davies, *Esq., F.R.S., &c.: with Notes on some of the Topics, by* Mr. Davies*.

To the Editors of the Philosophical Magazine and Journal.

Gentlemen,

THE inclosed letter appears to me to contain a very perspicuous statement of the character, present state, and ulterior modes of proceeding of the algebraic theory of equations; and I think it contains many important suggestions for those analysts who may hereafter give their attention to the subject. I have ventured to add a few notes, chiefly relative to numerical equations,—a subject to which particular but well-known circumstances have caused me to give much attention. These notes, I hope, will not be without their use.

I am, &c.,

Royal Military Academy,
March 9, 1848.

T. S. Davies.

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2 Church yard Court, Temple,
February 19, 1848.

My dear Sir,

IN our conversation of yesterday, I mentioned to you an idea that has for some little time occupied my thoughts.

* Communicated by Mr. Davies. For distinction, Mr. Davies's notes are printed in smaller type.