5·45 a.m., although the shock started from the focus, 1280 kilometres away, at 6.10, they examined their data with due scientific caution, and so discovered that the local time-standard of Bombay accounted for the apparently negative result; but as they obtained from their newspaper a positive record for the Calcutta seismograph, the application of the same system of scientific criticism of the time-standards did not occur to them. As a consequence, they arrive at the astonishing result that, whilst the earthquake waves travelling southwards to Bombay had a speed of 4·266 kilometres a second, those which were transmitted south-eastwards had a speed of 0·700 kilometres only.

The rest of the paper consists of "facts" and "inferences" of this kind, and whilst most are unimportant, it is desirable, perhaps, to point out that the epicentre determined by the authors is far removed from the true one. They have had to stretch their epicentre for more than forty miles to the west to account for the "complete destruction" of Pathankot. I was at Pathankot soon after the earthquake, and found it difficult to discover even a masonry crack in the town; even a few more newspaper cuttings would have shown the authors that the place was practically undamaged.

After picking a few pebbles out of this conglomerate of truth and fiction, one wonders why the paper was ever published at all. The very newspaper from which they obtained their data must have informed the authors that a thorough investigation of the earthquake had been organised by the Geological Survey. As both authors were in Madras at the time, one would imagine that a subject sufficiently interesting for a serious paper in a leading scientific journal would be worth, at any rate, a few more newspaper cuttings, even if a personal visit to the affected area were thought to be, for private reasons, inconvenient. We take it for granted that the long experience of both authors must have brought them into contact with the etiquette observed by scientific men, and that neither would consciously risk the recognised danger of forestalling the results of a thorough investigation by the publication of conclusions obtained from unverified data. But whatever the object, if the editor of a leading scientific journal can join in the production of such a paper, the future of scientific literature in Germany may yet give us entertainments as surprising as any of the recent efforts of the Russian Navy.

Of the Kangra earthquake, as well as of the other Indian questions which have been treated recently in the *Centralblatt* with an equal regard for accuracy, those who wish to know the truth will be provided with details in due season. Within a few days after the disaster occurred, every telegraph operator, meteorological observer, and district official north of the latitude of Bombay was provided with a complete guide for reporting the resulting phenomena, and the reports so obtained have since been supplemented by a detailed examination of the affected area by five officers of the Geological Survey. The observations made will be summarised first in the next part of the records, and the full details will form a special memoir, now in course of preparation. When these reports are ready, it will be seen that the actual facts, though in ways interesting and novel are scarcely so strange as German fiction.

T. H. HOLLAND.

Calcutta, July 20.

The Transverse Momentum of an Electron.

WHEN Newton's third law is applied to an electron, it makes

$$\mathbf{F}=\dot{\mathbf{M}}+\dot{\mathbf{N}}, \qquad (1)$$

where $\mathbf{M}$ is the "momentum" in the field, or that part of the time integral of the force on the ether which is in the field, or $\Sigma\,\mathrm{V}\mathbf{DB}$, and $\mathbf{N}$ is the momentum already wasted, whilst $\mathbf{F}$ is the applied force on the electron. Similarly, Newton's fourth law (or the Scholium to the third) makes

$$\mathbf{Fu}=\dot{\mathrm{U}}+\dot{\mathrm{T}}+\mathrm{W}, \qquad (2)$$

if $\mathbf{u}$ is the velocity of the electron, U the electric and T the magnetic field energy, and W the rate of waste of energy.

Now, both W and $\dot{\mathbf{N}}$ are known in terms of the velocity and acceleration of the charge at any moment by formulæ I gave in NATURE, October 30, November 6, 1902. But when applied to (1), (2), these equations do not let us determine $\mathbf{M}$ generally in terms of the velocity and acceleration, on account of the variability of the state of the field, and the waste of energy and momentum. $\mathbf{M}$ is indefinite. But in long-continued forced circular motion of a charge, $\dot{\mathrm{U}}+\dot{\mathrm{T}}=0$. So

$$\mathbf{Fu}=\mathrm{W}=\mu\mathrm{Q}^2a^2/6\pi v\kappa \qquad (3)$$

(*loc. cit.*), where Q is the charge, and a the acceleration (or u^2/R, if R is the radius of the orbit). Also, $\kappa^2=1-u^2/v^2$. The direct or $\mathbf{u}$ component of $\mathbf{F}$ is therefore known. We also have (*loc. cit.*)

$$\dot{\mathbf{N}}=(\mathbf{u}/v^2)\mathrm{W}. \qquad (4)$$

Using this in (1), along with (3), we come to

$$\kappa^2\mathbf{F}_1=\dot{\mathbf{M}}_1, \qquad \mathbf{F}_2=\dot{\mathbf{M}}_2, \qquad (5)$$

where $\mathbf{F}_1$ is the $\mathbf{u}$ component, and $\mathbf{F}_2$ the transverse component, towards the centre.

Thus only the part $\kappa^2\mathbf{F}_1$ of the direct force is associated with the transverse or centripetal force $\mathbf{F}_2$ in keeping up the revolving state, the rest of $\mathbf{F}_1$, that is, $(u^2/v^2)\mathbf{F}_1$, being the wasted part as regards momentum, although the whole of $\mathbf{F}_1$ is concerned in the waste of energy.

Now, $\dot{\mathbf{M}}=\mathrm{V}\mathbf{nM}$, if $\mathbf{n}$ is the angular velocity. That is,

$$\dot{\mathbf{M}}=\dot{\mathrm{M}}_1\mathbf{u}_1+\mathrm{M}_1\dot{\mathbf{u}}_1+\dot{\mathrm{M}}_2\mathbf{a}_1+\mathrm{M}_2\dot{\mathbf{a}}_2, \qquad (6)$$

if $\mathbf{u}_1$ and $\mathbf{a}_1$ are unit vectors, making

$$\dot{\mathbf{u}}_1=(u/\mathrm{R})\mathbf{a}_1, \qquad \dot{\mathbf{a}}_1=-(u/\mathrm{R})\mathbf{u}_1. \qquad (7)$$

Also $\dot{\mathrm{M}}_1=0$, $\dot{\mathrm{M}}_2=0$, because the motion is steady. So we convert (5) to

$$\kappa^2\mathbf{F}_1=\dot{\mathbf{M}}_1=-\mathrm{M}_2(u/\mathrm{R})\mathbf{u}_1, \quad \mathbf{F}_2=\dot{\mathbf{M}}_2=\mathrm{M}_1(u/\mathrm{R})\mathbf{a}_1. \quad (8)$$

Finally, although we get no formula for M_1, we do obtain a complete formula for M_2, viz.,

$$\mathrm{M}_2=-\,\mu\mathrm{Q}^2a/6\pi v\kappa^2. \qquad (9)$$

This is the transverse momentum of Q in steady circular motion, without any limitations upon the size of the velocity and acceleration, save the usual ones, $u<v$, and a not excessively great in regard to the diameter of the electron.

It would seem that an integration over the whole field, in which $\mathbf{E}$ and $\mathbf{H}$ are known (*loc. cit.*), is required to find $\mathbf{M}_1$, the direct momentum. If, however, the acceleration is infinitesimal, the known formula for M_1 in steady rectilinear motion may be employed, viz. $\frac{1}{2}\mathrm{M}_1u=\mathrm{T}$.

Finally, I have pleasure in saying that Mr. G. F. C. Searle, F.R.S., led me to see that my waste formulæ led to the formula (9) for the transverse momentum, by submitting to me a calculation of M_2 in the special case of infinitesimal acceleration and velocity. He made no use of the waste formula, not being aware of it, but, since in the circumstances the waste is infinitesimal, it did not matter. In fact, $\frac{1}{2}\mathrm{M}_1u=\mathrm{T}$ leads to the reduced special value of the transverse momentum when u and a are infinitesimal. The argument became somewhat obscure by the want of comprehensiveness, but the result agrees with (9).

OLIVER HEAVISIDE.

August 20.

A Parasite of the House-fly.

I SHOULD be very glad if Mr. Hill (p. 397) would send me a few specimens of the *Pseudoscorpiones* he has found attached to common house-flies, and I will endeavour to identify them for him. There are several genera of this order represented in the British fauna, and it is probable that all the species occasionally attach themselves to the legs or wings of larger insects and arachnids. There is some doubt, however, whether this is a case of true parasitism. It may be that the occasional association of these small arachnids with larger and more rapid arthropods is of importance to the species in providing a means for a wider geographical distribution.

SYDNEY J. HICKSON.

The University, Manchester, August 25.