and the hair-colour from seven to fourteen are but little, in England at any rate, subject to environmental influence. The cephalic index remains almost constant throughout life. Now the mean value for the fraternal correlation for these three characters is 0·5161, and for stature, span, forearm and health, which might be supposed to be largely influenced by environment, it is 0·5179. It thus seemed to me that environment was not an important factor in modifying the correlation of the *physical* characters between brothers. In other words, *environment does not influence the constant uniformly in one direction.* This view was apparently appreciated by Prof. Cockerell when he wrote "the treatment of successive children is not the same." Any influence of environment, strange as it may seem, was thus found to be negligible. Turning to the intellectual characters, my own *a priori* conception was that I should for the first time be able to distinguish between nurture and heredity. I expected much higher correlations in the case of temperament and probity than in that of physique. I was therefore somewhat surprised when the values came out much the same as in the case of the physical characters, say an average of 0·5. Of course it is open to Prof. Cockerell to say that 0·3 of this only is due to heredity and 0·2 to environment, or whatever other division appears to him probable, but he will then have to explain why the sum of the two makes 0·5, and why the influence of heredity is less in the intellectual than it appears to be for the physical characters. There is the obvious direct scientific interpretation which seems to me the true one, environment does not act in one direction in *either* case, and the mental and physical characters are inherited precisely at the same rate. To those who have taken the trouble, as I have done, to examine carefully the mental characteristics of a family at intervals of a century apart, so that we are not troubled by the co-environment peculiar to brothers, it is needless, perhaps, to urge the very strong inheritance of mental qualities. If Prof. Cockerell attributes it to his third factor, "pre-existing soul," I should, indeed, be proud to have aided in the demonstration of its reality, although I fail entirely to see how it is to be done "by just such methods as Prof. Pearson employs." Meanwhile most people will, I think, prefer to stick to heredity.

Of the last paragraph of Prof. Cockerell's letter I understand not a word. Correlation is quite independent of variation, and although skull capacity is highly variable as compared with length of femur, I see no reason for supposing the former is therefore less strongly inherited than the latter.

I have not touched on the influence of "local races" on my data, because that appears to be a factor which has escaped Prof. Cockerell, and so I am not bound to state a doubt which I have well considered in order to reject it.

KARL PEARSON.

Magnetostriction of some Ferromagnetic Substances.

WE avail ourselves of your valuable Journal to give a short notice of some new results, obtained in our researches on magnetostriction, being a continuation of our investigation on the same subject, given in the "Rapports présentés au Congrès international de Physique," t. ii., by one of us.

It was generally believed that ferromagnetic bodies show change of length by magnetisation, but not of volume. Minute as the effect generally is, it is now placed beyond dispute that iron, nickel, cobalt and especially steel differ also in bulk in the magnetised state from that in the unmagnetised. In the course of our researches on the magnetostriction of different ferromagnetic bodies in the form of ovoids we came across a substance which shows a remarkably large increase of volume.

Examining the magnetostriction of reversible nickel-steels of different composition, which were kindly placed at our disposal by Dr. Guillaume and M. Dumas, we find that alloys containing 46 per cent., 36 per cent. and 29 per cent. of nickel all show increase of length several times greater than that observed in ordinary iron. But far more striking is the change of volume; of the three above-mentioned alloys, the effect increases as the percentage of nickel becomes less; with 29 per cent. alloy we observed a motion of 5 mm. of the liquid in the capillary tube (diam. 0·4 mm.) attached to the volumenometer containing the specimen (volume $v = 10$ c.cm.) under examination. Thus the greatest change of volume by magnetisation amounts to $\delta v/v = 51{\cdot}1 \times 10^{-6}$ in H = 1690 C.G.S. With ordinary iron, the same change $\delta v/v = 1{\cdot}2 \times 10^{-6}$ in the same field, being only about 1/40th of that observed in nickel-steel. The magnetisation of 25 per cent. nickel alloy is so feeble that it is impossible for it to be magnetometrically measured, and the change of length is inappreciably small, but the volume change is measurable and amounts to $0{\cdot}2 \times 10^{-6}$ in H = 1790. It is thus quite probable that there is an alloy containing somewhat more or less than 29 per cent. of nickel that indicates largest increase of volume by magnetisation.

We at first thought it would be possible to trace some connection between the thermal expansion and the change of length by magnetisation. No such relation seems to exist; the 36 per cent. alloy, which is the least expansible by heat, indicates tolerably large elongation by magnetisation.

As regards the Wiedemann effect, nickel-steels behave very much like iron, showing the maximum amount of torsion in moderate fields.

As is well known, the behaviour of cast cobalt, as regards the change of length by magnetisation, is opposite to that of iron, but the volume change in the same metal is much smaller. By annealing cobalt in a charcoal fire it assumes a pale ashy colour, and the magnetic character is greatly changed. The metal becomes less magnetisable, and shows constant decrease of length accompanied by increase of volume.

We have also found, by actual experiment, that the effect of stress on magnetisation and the magnetostriction in cobalt and in nickel-steel are reciprocally related to one another, as was already established for iron and nickel.

H. NAGASKA,
K. HONDA.

Physical Laboratory, Imperial University,
Tokyo, December 3, 1901.

Results of International Magnetic Observations made during the Total Solar Eclipse of May 17–18, 1901.[1]

To test further the results obtained by the United States Coast and Geodetic Survey magnetic parties during the total solar eclipse of May 28, 1900, regarding a slight magnetic effect that may be attributable directly to some change produced in the electrification of the upper atmospheric strata by the abstraction of the sun's rays due to the interposition of the moon between the sun and the earth, an appeal was made for international cooperation in magnetic and allied observations during the recent total solar eclipse.

The repetition of the observations was doubly interesting owing to the fact that the present eclipse occurred in the opposite magnetic hemisphere to that of the year 1900, and hence the opportunity was afforded for ascertaining whether the magnetic effect was reversed in its general character to that of 1900, as is, for example, the case with the diurnal variation in passing from one magnetic hemisphere to the other. The conditions, however, for obtaining observations at a number of stations distributed along the belt of totality, as was done in 1900, and thus testing whether the magnetic effect again followed directly in the wake of the shadow cone, were not favourable owing to the present location of the belt of totality.

In response to the appeal, simultaneous magnetic observations were made on May 17 from 14 to 21 o'clock Greenwich mean astronomical time—an interval amply covering the time of the eclipse—at a number of stations encircling the entire globe, three of which were in the belt of totality. The prime purpose of making the observations so as to cover the entire globe was to furnish the possibility of separating a possible eclipse magnetic effect from a contemporaneous magnetic storm of the usual type. The eclipse effect, for instance, doubtless would be confined to a very small belt, whereas a customary magnetic storm, in conformity with the usual experience, would manifest itself at practically the same moment of time over a very large area and thus be felt at stations far from the totality belt.

At none of the outside stations has a disturbance of any appreciable size been thus far reported to me, the general consensus of opinion of observers at these stations being that "nothing unusual occurred."

At the three stations within the belt of totality the majority of opinion is that something unusual did occur during the time of the eclipse.

[1] Presented before the meeting of the Astronomical and Astrophysical Society at Washington, December 30, 1901.