On some Unapparent Contradictions at the Foundations of Knowledge.

An argument parallel to that by which Mr. Tolver Preston proposes to prove that Space is nothing will prove with equal cogency that Time is nothing. But if Space is nothing and Time is nothing, then he has the choice of two alternatives, neither of which will he find particularly acceptable. If Space and Time are both nothings, they are identical. If Space and Time are not identical, then they are two nothings which differ. What is the difference between two nothings?

I would suggest that Mr. Preston should read Mr. Herbert Spencer's views on "The Relativity of Knowledge," contained in Chapter IV. of "First Principles." On his carefully thinking this out, and understanding it, I am willing to hope that the title I have adopted for this letter may appear to him appropriate to the subject-matter which he has brought under the consideration of your readers. F. Howard Collins.

Churchfield, Edgbaston.

Extraordinary Fog in January 1888, at Shirenewton Hall, Chepstow.

The recent fog has been so remarkable that it seems desirable to record its principal features. From the 7th to the 14th the air was completely saturated with moisture. The most notable feature was that of cold air passing over a warm ground, for from the 11th to the 15th the greatest cold on the grass did not descend to that read at 4 feet. Such a condition of the air as this has not been noticed since I commenced observations in 1838.

The following readings of the thermometers will illustrate this:—

Date.	Temp. 4ft. 10 a.m.	Diff. bet. wet and dry.	Min. 4 ft.	Min. grass.	Diff.
Jan.	°	°	°	°	°
7	43·3	0·0	40·0	34·5	−5·5
8	45·6	0·0	42·1	37·2	−4·9
9	41·2	0·0	37·0	30·3	−6·7
10	34·3	0·0	32·8	28·1	−4·7
11	36·7	0·0	33·3	37·3	+4·0
12	29·8	0·0	29·3	30·5	+1·2
13	28·3	0·0	26·7	28·3	+1·6
14	32·0	0·0	25·0	29·5	+4·5
15	33·9	1·0	28·0	30·0	+2·0
16	30·0	0·5	27·0	27·0	0·0
17	30·5	1·0	29·7	29·7	0·0
18	28·6	0·0	27·0	27·0	0·0
19	31·7	0·4	26·4	24·8	−1·6

Throughout the 12th after 9 a.m. the temperature on the grass was above 32°, whilst it was a frost from the height of 1 foot upwards; at 10 a.m. the temperature on grass was 32°·8, at 4 feet 29°·8, and at 10 feet 28°·6.

The fog lasted from the evening of the 6th till 3 p.m. of the 14th. On the 7th the clouds moved rapidly in W. current, and on the 8th they moved rapidly in S.W. current; on the 9th nearly calm and cloudless overhead; from the 10th to 14th overcast (except from 11 a.m. on the 12th till 12.40 p.m.). The chief direction of the wind was: 8th S.S.W., 9th S.S.E., 10th W.S.W., 11th and 12th calm, and from 13th to 18th between N. and N.E., and on the 19th E.S.E.

The fog was wet and yielded much moisture, viz.:—

7th ·079, 8th ·008, 9th ·015, 10th ·017, 11th ·031, 12th ·013, 13th ·020, 14th ·020, 15th ·023.

The barometer was very high, and almost stationary, reaching a maximum on the 9th at 10h. 30m. a.m., viz. 30·75 inches corrected and reduced to the sea-level.

On the 11th the fog cloud moved in a south current till 3 p.m., when it became north, and continued so throughout the 12th. On this day on the side facing the fog current every leaf and twig had a horizontal deposit of ice, increasing in length from half an inch at 4 feet above the ground to fully an inch at 10 feet; the outside edge of this ice being as thin as the fine edge of a knife; and the whole upper surface of all laurel and other large leaves that were horizontal had a coating of ice, so thin (although it could be detached without breaking) as almost to resemble gold-leaf, on which were transparent impressions of every irregularity, however minute. On the side of trees opposite to this current, instead of rime there were nearly pear-shaped transparent drops of frozen water, of various sizes, mostly as large as one-eighth of an inch in diameter; they were situated *not quite* at the point of every leaf; no leaf was without a frozen drop, and this had an extraordinary appearance, more especially amongst the crowded leaves of such plants as *Pinus insignis*, *Abies Webbiana*, &c. On the opposite side of these fir-trees the appearance was equally singular, as each leaf looked like a knife-blade of one-sixth of an inch in width, with a square apex. The ground-temperature being above 32°, the vivid green of the grass was a great contrast to the ice on the trees. E. J. Lowe.

"The Art of Computation for the Purposes of Science."

In a paper with the above title, in Nature, vol. xxxvii. p. 237, Mr. Sydney Lupton refers to some of our work as affording a good example of "the natural tendency of the human mind . . . . to exalt the accuracy of one's own experiments."

The experimental work referred to was a determination by the dynamical method of the vapour pressures of liquid benzene. A curve was drawn to represent these relations; three points were chosen, and the constants for the formula $\log p = a + ba^t$ were calculated. Mr. Lupton finds fault with the number of decimal places given for these constants, and makes three statements which are intended to put the experimental work in as unfavourable a light as possible so as to heighten the contrast with the extreme accuracy of the calculations. Mr. Lupton says: "Nine places of decimals are given with apparent confidence, when (1) only three of the whole number of experiments were made even in duplicate." We do not quite understand this statement, for on reference to the original paper (*Phil. Mag.*, Jan. 1887) it will be seen that the last six experiments in Series I. overlap the first six in Series II., while the last seven of Series II. are within the same limits of temperature as the first four of Series III. The second statement is that "the last pressure, 755, was obtained not by experiment at all, but by extrapolation from a freehand curve, the highest experiment being 79°·6 and 743·1 mm." We would point out that the experiment referred to is not the highest, for on the preceding page in our paper the boiling-point 79°·9 at 753·4 mm. is given. Again, the curve was not drawn by freehand, but by means of engineers' curves, which give very much more accurate results. It is quite true that the last pressure was obtained by extrapolation, but an extrapolation of 0°·1, or even of 0°·4 does not seem very excessive with a range of 80°. Mr. Lupton states, thirdly, that "a difference of $\frac{1}{5}$° at low temperatures produced no change in pressure which was appreciable by the apparatus used." But, as a matter of fact, at 0° a difference of 0°·1 corresponds to a difference of pressure of 0·15 mm., which is quite appreciable on our gauge. Perhaps, however, Mr. Lupton refers to the experiments at 36·15 mm., in which at the same pressure two *different* thermometers registered temperatures which differed by $\frac{1}{5}$°.

Mr. Lupton lastly gives much simpler constants, calculated from our data, and compares the pressure at 60°, calculated from them and from our constants, with the pressure given by Regnault. It happens that the number obtained with the simpler constants exhibits greater concordance with Regnault's value. Now while we would agree with Mr. Lupton in classing Regnault (as far at least as some of his work is concerned) with the select few who are entitled to an extra number of decimal places, yet we would point out that Regnault did not always succeed in obtaining perfectly pure substances to work with, and some of his results are rendered almost valueless on that account. In this case, for instance, the melting-point of Regnault's sample of benzene was 4°·44, whereas after the most careful purification we find that it melts at 5°·58, and the value obtained by Fischer (*Wiedemann's Annalen*, xxviii. 400) is almost exactly the same as ours. Again, Regnault failed to observe the existence of a difference in the vapour pressure of solid and liquid benzene (and other substances) at the same temperature, while this difference has been measured by Fischer by the statical and by ourselves by the dynamical method.

We are quite willing to admit that our decimal points are carried further than is necessary for the calculation of the vapour pressures, but we have frequently had occasion to calculate the values of $\frac{dp}{dt}$ for various substances, and we have found that in order to obtain regular values a large number of decimal places are required; if a smaller number are employed the