

Atomic Theory," p. 828 of the same issue, indicates an interpretation of physical phenomena essentially the same as the older physiological theory of experience. There is nothing metaphysical in the conclusion that the limiting subjective unit is a *minimum sensibile*, for the individuality associated with events is still our three-dimensional brain-consciousness. If there be metaphysical regions, that is, states of energy, beyond or within those we term physical, we should have to evolve finer sense perceptions in order to become aware of them; and what is now hypothetically metaphysical would have become physical. Present interpretations of physical theories, however, do not appear to suggest the possibility of such evolution.

That one state of matter permeates grosser states of lower atomic velocity is a fact quite unrelated to our present powers of sense perception. We can enhance these powers to some extent by means of radio instruments, and experience a vicarious sensation of being in two places at once; but we cannot see *simultaneously inside and around* our physical bodies or the earth, and, therefore, we are unable to know what, if any, is the subjective state of high-power radioactive substances. Absolute permeability, absolute velocity, absolute time or absolute consciousness is as incomprehensible to our present organs of perception as 'absolute size'—a contradiction in terms, for size can relate only to a three-dimensional form of physical matter in space, and particles must become blended with energy at infinity. A formless, synthetic, immaterial substance of absolute and, therefore, ubiquitous density would be a state of absolute subjectivity, 'absolutely' metaphysical for us.

W. W. L.

May 25.

Activation of Hydrogen by Electric Discharge.

My attention has just been directed to the correspondence under this heading in NATURE of Jan. 21 and Mar. 10. Dr. Lunt has kindly summarised the experimental evidence which leads to the rejection of explanations of the type proposed by Mr. Glockler, and in this connexion I have nothing to add.

It is important to note, however, that in a large number of experiments, described very briefly at the commencement of my paper and in greater detail in the thesis, no activation could be detected. It appears that evidence of activation may be obtained only when the detecting agent is sufficiently close to the discharge tube and at pressures below about 5 cm. of mercury. Paneth and his co-workers, in a paper published at the same time as mine, also report failure to obtain active hydrogen by many of the methods described in the literature of the subject. It seems probable, indeed, that the greater part of the previous work describing methods of preparation and properties of active hydrogen other than monatomic hydrogen obtained at extremely low pressures may prove to be without value. If this be so, my subsequent experiments, together with those of Dr. E. J. B. Willey, who reports the formation of active hydrogen in the 'condensed' discharge as used for the production of the nitrogen after-glow, constitute the principal evidence for the existence of this substance. Further details concerning the active hydrogen which Dr. Willey has obtained would, therefore, be of great interest.

In the March issue of the *Journal of the American Chemical Society*, Messrs. Smallwood and Urey also describe unsuccessful attempts to prepare active hydrogen by the usual methods. In their paper it is stated that my results are open to criticism on the

ground that I did not sufficiently guard against the possibility of sulphur dust being blown back into the discharge. This is incorrect, for adequate precautions were taken to prevent any accident of the nature described.

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April 28.

Subsidiary Rectangles as Applied to the Formation of Magic Squares.

IN NATURE of Jan. 14 I gave an 'associated' rectangle 8×3 , which is the smallest rectangle that will also provide the property, that the diagonals one way also sum to the same amount as the rows. I give below a similar rectangle in the smallest possible numbers (non-consecutive).

In NATURE of Feb. 4 I gave the smallest similar rectangle with consecutive numbers, 9×3 for order 27.

As the diagonal property is not necessary in order 27 with rectangles 9×3 , and order 30, with rectangles 10×3 , can only be constructed with non-consecutive numbers, order 33, with rectangles 11×3 , is the smallest order in which the diagonal property is essential in the rectangles 11×3 , with consecutive numbers, for the formation of associated pandiagonals.

I give the three additional rectangles, where in each case the diagonals from left to right sum to the same amount as the rows, and the rectangles are each associated.

8×3	10×3
12 20 18 11 3 27 19 2	20 25 6 2 19 11 15 4 31 27
4 13 23 6 22 5 15 24	23 22 14 29 8 24 3 18 10 9
26 9 1 25 17 10 8 16	5 1 28 17 21 13 30 26 7 12
112×42	160×48
	11×3
	21 29 26 20 9 1 11 10 12 16 32
	28 4 3 7 19 17 15 27 31 30 6
	2 18 22 24 23 33 25 14 8 5 13
	187×51

J. C. BURNETT.

Barkston,
Nr. Grantham, Lincs,
May 15.

Rainbow Visible after Sunset.

It may be of interest to record that about sunset on Monday, June 4, there was a fine rainbow here which persisted until the sun was well below the horizon. The last trace of it vanished at 20^h 11^m G.M.T., at which time the altitude of the true sun was approximately *minus* 1° 30'. Making a generous allowance for refraction, this would still put the upper limb of the apparent sun very appreciably below the horizon. This is perhaps the more remarkable in that there was a low bank of cloud along the western horizon. The great altitude of the top of the bow was very striking, and it did not, of course, reach down to ground level, but faded out at a considerable height, which there was not time to measure. My longitude and latitude were 4^m 28^s E., 51° 21' N.

B. M. PEEK.

Gorse Cliff,
Herne, Kent,
June 12.