

space. A connecting æther, sharing with atomic matter the property of extension, does appear to be necessary to render distance and space between the heavenly bodies objective reality. The æther can, apparently, be reconciled with the Einstein equations.

Relativity has, at any rate, rendered the inestimable intellectual service of bringing physics into contact with metaphysics. In respect to questions of ultimate reality we do appear to some extent to be drifting into a position of philosophical idealism. It is evidently in relation to mind that the physical universe acquires its fullness and richness, and certain qualities of matter can scarcely be thought of as standing alone apart from mind. A case in point is beauty, a quality which was referred to by Sir Oliver Lodge in *NATURE* of February 17. Beauty differs from the grosser qualities of matter in that its objective foundations, namely, various harmonious dispositions and groupings of parts, are only incidentally, not directly, the expression of physical forces. Consequently, beauty as beauty is relative to mind, a subjective reality, and the sense of it in man a faculty of the spirit.

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March 20.

Molecular Structure and Energy.

IN some recent communications on the structure of molecules based on the Lewis-Langmuir theory the question of the energy of molecules seems to have been left out of account. The models for halogen molecules proposed by Prof. A. O. Rankine (*Proc. Roy. Soc.*, 1921, February), for example, whilst they agree well with the viscosity data, are not in agreement with the specific heats of the gases. The models of the nitrogen and nitric oxide molecules proposed by Langmuir, and those of the carbon dioxide and nitrous oxide molecules proposed by Rankine, are also at variance with the specific heats of these gases.

A molecule composed of atoms rigidly attached in line should have a ratio of specific heats of 1.400. Carbon dioxide and nitrous oxide are assumed to have three atoms in line. The value of c_p/c_v for these gases is of the order of 1.300. If nitrogen consisted of molecules as pictured by Langmuir, *i.e.* having two nuclei inside one perfect sphere, the ratio of specific heats would be 1.667. The value of c_p/c_v for nitrogen is 1.40.

I intend to develop this matter in a little more detail, but it seems worth while pointing out that a discrepancy appears to exist between the facts and the latest theory of atomic and molecular structure, at least as I understand it.

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March 26.

Oceanographic Research.

ONE can cordially agree with Dr. Annandale and Major Sewell as to the importance of all such intensive local work as they refer to in their letter in *NATURE* of March 31, p. 139; but is it oceanography?

"The investigation of the fauna of the Chilka Lake . . . a minute, almost isolated, fragment of the ocean" (to use their own words) seems exactly the type of excellent marine biological investigation which has been carried on by many institutions, committees, and individuals in various parts of the world (not the British Empire alone) in the past. Long may such continuous local work flourish and become enlarged in scope by the addition of those hydrographical and biochemical researches which should enable us to

understand better the causes of the observed faunistic distribution.

But these intensive studies of relatively small areas can scarcely be said to touch the great problems of the wide oceans as a whole, and cannot be regarded as an alternative to occasional more general expeditions making traverses of large areas and deep seas. The British Empire has interests beyond the coastal waters of the continents. By all means let us encourage local and minutely detailed work, and also advocate, when the time is opportune, that wider investigation of the open oceans which, in the opinion of many of us, might add much knowledge in various branches of science.

W. A. HERDMAN.

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Why do Worms Die?

THE middle of March saw the slaughter of millions of worms. Morning by morning the pavements, roads, and pathways were strewn with the dead. Great and small, young and old, of every known species and genus, from *Lumbricus* to *Dendrobæna*, lay prone. Even if they were able to reach the pasture, lawn, or grass-plot alive, they had not the power to burrow and recuperate. What caused their death? I have asked the question for thirty years, but have never found the answer.

Four main theories have been advanced. They are killed, folks say, by (1) parasites, (2) cold, (3) rain, or (4) poison.

The first theory has long been maintained. It was held by Darwin ("Vegetable Mould," p. 14), who said that worms were affected by a parasitic fly. The parasites of worms are of very many kinds, but I have collected large numbers of dead and dying worms and examined them with care, yet have found nothing abnormal in this direction. Since worms are cold-blooded creatures they can endure a low temperature without suffering. Moreover, they are often found dead in the spring when the temperature recorded for the night has not been below 34°.

Darwin (p. 125) speaks of Mr. Scott's surprise when told how long they could endure being submerged, "as he did not know how long worms could survive beneath water." It is practically impossible to drown them in a brief time, such as is allowed for their slaughter day by day at this season of the year. And yet in some way showery weather seems to be essential. After March 21 no showers fell at night, and no worms lay dead in the morning.

There remains the miasma theory. "Nature uses poison gas," says the speculator. This theory would seem good if worms were found dead on tarmac roads, but not on gravel paths, and if they died in a similar way all the year round. But such is not the case. Thus every theory seems to fail.

The worms appear to be paralysed. They crawl at first with vigour, then the rate of progress declines. Eventually they cease to move, die, swell in places or along the whole length of the body, and ultimately become the prey of various scavengers; but are totally ignored by the birds.

It seems clear that the conditions required are warm days and evenings, moisture in the way of showers during the night and early morning, and then a cold snap, but not necessarily a frost. Does the combination of cold and moisture paralyse them? Are the dorsal pores choked? Or are they exhausted in their efforts to regain their closed burrows? At present I am unable to carry out the research and experiments upon which alone a satisfactory judgment can be based. Has anyone ever found the answer?

HILDERIC FRIEND.

"Cathay," Solihull.