

pictures in which lines with the most wonderful contortions have been supposed to represent the effects of adding new dimensions to space. They are useful only as illustrations of the enormous gap separating this so-called hyperspace from the space of human experience. There have latterly been attempts to go much further and to import the creations of Riemann's imagination into the analysis of physical problems, into speculations on the construction of space beyond the range of human vision, and to postulate on the existence of space of different kinds, including curvilinear space, all of which I deem to be entirely outside the province of legitimate induction. The word "curvilinear" describes a predicate or function of matter, but not of space; as well might it be applied to a vacuum. Nor do I exactly know what Prof. Einstein means by relative space as used by him. The word "relative" has a perfectly recognised meaning in philosophy as the antithesis of "absolute." If it is used by him in this sense, assuredly there is no novelty in it. It was the fashion of the philosophers of the ancient world and of the schoolmen of medieval times to separate space and time from the other phenomena of Nature. They held that both have an objective existence, and are not, as they deemed, entirely subjective and transient, like the more obvious presentations of sense. There are many rebels against this notion now who claim that space is as much entitled to be called a subjective phenomenon as is colour or taste, and that a man void of the senses of sight and touch could have no cognisance of what we mean by space. As to the size of any portion of space being relative only, I happen to have myself a personal proof of it in the fact that, my two eyes having lenses of different curvature, any object seen with one appears to my consciousness as one-third larger than when seen by the other. In the sense here mentioned I understand the word "relative," but I fail to understand what Prof. Einstein means by it.

Meanwhile, let us try to be content with our limitations. One of the earliest antinomies recorded was the question of whether space is limited or unlimited. It remains an antinomy still, and must remain so. The one alternative is as incredible and unimaginable as the other, and the Sphinx refuses to reply when she is asked about it. There is no calculus available by which men with limited faculties and all prone to error can map out infinity, discover the secrets of the realms beyond the stars, and transcend the world accessible to our senses, and which alone can be equated with, and adequately tested by, inductive methods. Let us leave to the pure mathematicians the delightful occupation of rambling through wonderland with their imagination. It would be unreasonable to deprive them of their mental relaxations and amusements in the land of dreams in which they have such ample scope for mental dexterity. All I maintain is that these dreams are entirely out of place in that branch of inductive thought called science. My most gifted friend Mr. Hobson, of Queens' College, Cambridge, a very original mathematician, in a lucid account of the aims and purposes of pure mathematics, emphatically protests against mixing up that empyrean study with the mundane realities of plebeian physics.

Lastly, let us remember a graphic phrase of Mansel when dealing with transcendentalism in philosophy. He warned his pupils that "a man who tries to look down his own throat with a candle in his hand must take care that he does not burn his back hair."

I have touched only the fringe of the subject raised

in this most interesting discussion, for which we are all grateful, but I feel that whether the space discussed in it is limited or not, yours is very definitely limited, and I must trespass on it no further.

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45 Lexham Gardens, February 21.

#### Natural History of Porto Santo.

THE Island of Porto Santo, one of the Madeira group, is probably best known to biologists on account of the famous rabbit still found commonly there. Darwin showed that the animal differed conspicuously from the English rabbit, and inferred that it had evolved into a new race since its introduction into the island some hundreds of years ago. Haeckel gave it a distinctive name, *Huxleyi*. It is, indeed, a distinct race or subspecies from the English rabbit, but zoologists had failed to observe that it was identical with the Lusitanian animal, which had not then been segregated by them. Thus the Porto Santo rabbit loses its importance as evidence of evolution, being, in fact, the South European subspecies of *Oryctolagus cuniculus*.

To the modern biologist, however, Porto Santo has far more attractive features. It is a small island, some 6½ miles by 3 miles, but of irregular shape, with a number of adjacent islets. Yet on this small area are found as many as forty-one native species of Helicoid snails, the very much larger island of Madeira having only thirty-seven. A few of the forty-one are now extinct, being represented only by fossils or empty shells. On the other hand, the number may be considerably increased if we add the varieties and local races, some of them quite distinctive. In addition to the native species, there are some which have been introduced, and *Helix pisana*, in particular, exists in countless myriads, with many variations. It seems to have been no obstacle to the spread of this snail that the island was already occupied by a prodigious number of land mollusca. Whether the advent of *H. pisana* reduced the numbers of the native species it is hard to say, but the latter still abound everywhere.

The largest and finest snail of Porto Santo is *Pseudocampylaea Lowei*, Férussac, or *gigantea*, Lowe. It is a quite common fossil in beds which must apparently be referred to the Pleistocene, but it has been found living, and a perfectly fresh shell is to be seen in the British Museum (Natural History). I found no living specimens, but obtained several shells in ploughed fields, showing the pink apex and traces of the bands; certainly not fossils. It may be that agriculture has been the principal cause of the extinction (it is probably now extinct) of this fine mollusc. *Leptaxis fluctuosa*, Lowe, is another species which seems to be extinct, but I found a recent shell showing the coloured banding. The islets about Porto Santo are extremely interesting. The Ilheo de Cima, on which the lighthouse stands, is about 1200 metres long and less than 500 metres across at its widest part. It is scarcely 300 metres from the main island, and there are half-submerged rocks in the channel. Yet on this islet we find swarming under stones the very distinct and remarkable snail *Geomitra turricula*, Lowe, found nowhere else in the world! The large *Pseudocampylaea portosantana*, Sowerby, which is a sort of smaller edition of *P. Lowei*, abounds on the main island. But on the Ilheo de Cima it has not merely one distinct race, but two. On the top of the islet, near the end facing the main island, we find a very large, dark, depressed race, the greatest diameter

of which is 29-31 mm. This is the race *cimensis* of Wollaston. About the landing-place, on the east side, is another race, smaller than usual (maximum diameter 22-25 mm.), not dark, but well and conspicuously banded, and with the spire greatly depressed. It may be called race *evoluta*; it has possibly become distinctly segregated since Wollaston's time, since it combines the characters of the other forms, and is the sort of thing which might doubtless be obtained from them by careful breeding under artificial conditions. At the same time these races *cimensis* and *evoluta* exist to-day as pure types, very distinct and easily recognised, occupying different stations on the Ilheo de Cima.

In some ways the Ilheo de Nordeste, the most remote of the islets about Porto Santo, is even more interesting. It is a mere rock in the ocean, about 500 metres long and 300 metres high, somewhat less than 3 km. from the main island. With the aid of our boat's crew of strong Portuguese sailors, my wife and I were able to land and climb about the excessively rocky surface. The vegetation is scanty, but includes the beautiful stock, *Matthiola maderensis*, Lowe, and the orange-flowered Lotus. Ants and millipedes seemed to be entirely absent. On this lonely rock, and nowhere else, lives the beautiful snail *Cryptaxis forensis*, Wollaston, with dark, keeled shell and pink lip and apex. Here, and not elsewhere, is found (in great abundance) the small, button-like *Discula polymorpha* race *gomesiana*, Paiva. But here also is the invading *Helix pisana* and the native *Plebecula punctulata*, Sowerby, which abounds on the main island.

The curious little *Geomitra paupercula*, Lowe, abounds under rocks in dry places at Porto Santo and on the adjacent islets. It is unique in the group for its wide distribution, being found also in Madeira and all three Desertas, and in the Azores and Canaries. It sticks very tightly to the rocks or to any other convenient object. I once saw a beetle (*Helops*) walking along with one of these snails on its back. It is probable that at different times these snails have attached themselves to the feet of birds, and thus got carried across the sea.

The soundings taken many years ago by H.M.S. *Styx* (Capt. Vidal) show that Porto Santo rests on an elevated bank, indicating a former island perhaps six or seven times as large. The margins of this bank appear to be cliff-like, almost vertical, the depths suddenly increasing from, e.g., 45 to 200 fathoms. This might be taken to indicate the cliffs of the former island, perhaps dating from the Mesozoic. The oldest deposits on the island containing fossils are Miocene, and are marine. At Calheta Point one may see this Miocene material, with large shells and corals, mixed with dark volcanic rock, which seems to have been thrust up from beneath. The suggestion is obvious that the island dates only from the Miocene, but, apart from the *Styx* soundings, it seems improbable that the remarkable snail fauna has wholly evolved from some immigrant or immigrants since that time. The sandy fossil beds containing land shells must be considered Pleistocene. Wollaston calls these shells subfossil, but they are quite comparable with Pleistocene fossils elsewhere, and show about as much difference from the living fauna as might be expected. At the base of this series, in the Campo do Baixo, is a dense stratum of marine Pleistocene, which has been studied and will, I hope, be fully described by my friend Senhor A. C. de Noronha, a very keen and able naturalist who was born in the island.

The insect fauna of Porto Santo is scanty, but the collections obtained will doubtless prove to be of ex-

ceptional interest when studied. Three species of butterflies are common, *Colias edusa*, *Vanessa cardui*, and *V. callirhoë*, the last breeding abundantly on the nettle *Urtica membranacea*, Poir. Wollaston considered that specimens of the Porto Santo *V. callirhoë* were smaller than those of Madeira, but I could not see any difference. We found only two species of bees, both *Andrena*. No fossorial wasps could be found, though the sandy country seemed exactly suited to them. The numerous spiders appear to have no Pompilidæ to attack them. At the back of the town rises the tall Pico do Castello, and on its summit may be seen a building in which the inhabitants used to take refuge from the Moorish pirates. A cannon remains on the side of the mountain, half-buried in the earth. To-day the lowlands of Porto Santo are overrun, like those of Madeira, by the obnoxious little ant *Iridomyrmex humilis*, which has exterminated the once-abundant house-ant, *Pheidole megacephala*. But on the top of the Pico do Castello we found the *Pheidole* still holding out, with numerous strong nests.

The flora is scanty, and was not specially studied by us. We were interested to find the orchid *Gemmaria diphylla*, Lk., on the Pico do Castello and Pico d'Anna Ferreira. The Pico do Castello has been extensively planted with trees in recent years, and I thought the orchid might have been introduced with soil, but this seems unlikely in the case of the Pico d'Anna Ferreira, which remains in its original condition.

The people of Porto Santo are a hardy and industrious race who win a scanty living from the sea and soil. We found them exceedingly friendly and cheerful, and left them with strong feelings of regard. We were specially indebted to our guide, Senhor Juan do Pico, who knew every path and byway.

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Hotel Bella Vista, Funchal, Madeira,  
February 3.

### The Energy of Cyclones.

IN the recent discussion in NATURE on the energy of cyclones no mention has been made of tropical cyclones, although these are the most remarkable phenomena of their kind.

It is impossible to apply to these cyclones the theories which ascribe the energy of the rotating wind system to the re-adjustment of equilibrium of warm and cold masses of air within that system, since in the cyclones of the tropical zone temperature and humidity are symmetrically distributed. In these cyclones warm and cold sectors do not exist. The Indian meteorologists Henry Blanford, Sir John Eliot, Fr. Chambers, and W. T. Willson have published papers on the cyclones of the Bay of Bengal and the Arabian Sea, giving a full explanation of their origin and development. These very important works no longer receive the attention they deserve. They also throw much light upon the source of energy in these cyclones. I endeavoured to make a rough calculation of the energy contained within one of these whirls, taking into account the preceding pressure distribution over the hurricane region, and the results were in good agreement with the observed wind forces. I should therefore like to direct attention to this work.

The calculation was based upon observations of the Backergange cyclone. It is given in my "Lehrbuch der Meteorologie" (1901 edition, p. 579, footnote), as well as in a paper, "Remarks on the Origin of (Tropical) Cyclones" (*Meteorologische Zeitschrift*, 1877, August, p. 311). My calculation has no ap-