

he believes that the cave was supplied at a time when this region was a salt or brackish water estuary. Prof. Putnam therefore concludes that the blindness of these fish has been in no respect a consequence of subterranean life.

#### DISCUSSION.

Mr. BRITTON inquired whether any flora existed in the cave.

Mr. STEVENS replied that, so far as he was aware, no kind of vegetation had ever been found within it.

Dr. NEWBERRY remarked on the geology of the region adjacent to the Mammoth Cave. The limestone beds of this high table-land are jointed in the manner common to rocks, apparently by some sort of polarisation, producing fissures which run in a north and south, and an east and west, direction. The plateau is about 500 feet above the drainage, part of the drainage passing into the Green River, and part into the Ohio. No streams occur on the surface and the drainage is quite gradual. At the angle between these two rivers several streams are seen, bursting out of the cliffs at various heights above the Ohio; they are, so to speak, subterranean sewers, representing the underground drainage of the country; at one point three such streams pouring out of the rock form very beautiful cascades; and near Sandusky a full grown river flows out of the cliff of cavernous limestone. The beds consist of lower carboniferous limestone, with sandy layers beneath. In the vicinity occur portions of the great "blue grass region," one of the oldest parts of the continent, once an extensive highland, forming an island in the sea. Around this, rims of sediments were deposited, consisting of sandstones and limestones; while on the other hand, the continuous process of erosion, during the lapse of a vast period, removed the material of the table-land within, and converted it into a broad depression or basin, the "blue grass region," above which the present plateau of the encircling sediments now rises to a height of 500 feet.

The erosion of the joints in this plateau has resulted in the formation of the pits described by Mr. Stevens, but it is probable that some of these may reach 200 or 300 feet below the Ohio and Green Rivers. There is evidence, from borings in the Delta of the Mississippi, etc., that the Continent was formerly more elevated, standing 500 to 600 feet higher at New Orleans than at present; the drainage was much freer, the Mississippi being a free flowing stream, as well as the Ohio and other tributaries. Borings have been sunk in the present trough of the Ohio river, to a depth of over 100 feet below its present bottom, without reaching the true bottom of the trough, the ancient bed of the river, which is perhaps from 100 to 200 feet further down.

Evidences of the same elevation of the continent were observed in caves on an island in Lake Erie. Long stalactites projected from the roof of a gallery whose end was ordinarily filled with water at the present level of the lake. At times a strong and steady wind has blown down the level of the lake and partially drained this gallery; but even then a guide, John Brown, resident on the island, has swum through the gallery and found the stalactites projecting from the roof as far as he could go.

In regard to the origin of the blind animals, the view of Prof. Cope is probably correct, that they have been derived from the degeneracy of ancestors who once had perfect eyes. No fish is formed with poor eyes; but any organ may be atrophied by disuse, with consequent feeble flow of blood, decreased nutrition, and inevitable shrinking of important parts. An analogy is shown in a comparison of the jaws of prehistoric and modern men. At present our "wisdom teeth" are useless, there is no room for them in the shortened under-jaw; our food being softened by cooking, cut up, and boneless, requires less vigorous mastication; and from disuse, and the consequently insufficient development, these teeth often speedily fall away. In the prehistoric man, on the contrary, the jaws

were longer, roomier, supplied with more teeth—the "wisdom teeth" being well developed and kept in strength by constant use on coarse and rough food. The absence of the well-known stimulation produced by light, from the dark waters within the Mammoth Cave, has in the same way resulted in the atrophy of the organs of sight.

#### CORRESPONDENCE.

*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*

*To the Editor of "SCIENCE."*

We can sympathize sincerely with the Editor of *The Popular Science Monthly* in his indignation at being held a promulgator of the views of "pronounced atheists," because of his publication of "the papers of Herbert Spencer, and others of his class." "Pronounced atheism" finds little place in the history of philosophy or science, as in the history of mankind and human civilization in general. And Dr. Youmans is certainly in the right with his emphatic denial that Mr. Herbert Spencer, in particular, pronounces himself an atheist and seeks to persuade others to do likewise. He "and others of his class" have, indeed, been very out-spoken in questioning the literal truth of many popular beliefs and sacred traditions. But that there is in "religious ideas" no "vital element," that they correspond to no fact and represent no truth, Mr. Spencer has been far from asserting. On the contrary, the precise opposite is most strenuously maintained by him (see especially Spencer's *First Principles*, Part I.).

And yet, while all this is verbally true, we fear that Dr. Youmans, in his just zeal to defend himself and his friend, both goes too far in his statement of the latter's real position, and forgets those grounds which lend color of justification to the perfectly sincere supposition of many thoughtful people, that the practical, if not the professed or intended, tendency of Mr. Spencer's philosophy, is in the direction of virtual atheism.

If it were really true that "no man of the present age has reasoned out the foundations of man's belief in the existence of the 'Infinite and Eternal Spirit' with such a depth of analysis and logical force as Herbert Spencer," if, as Dr. Youmans further declares, it were strictly true that Mr. Spencer "has sought to show that the 'Infinite and Eternal Spirit,' of which all the phenomena of the universe are but manifestations, is the most absolute of all realities," then religion would owe to him a debt of gratitude, which it is inconceivable that the intelligent defenders of religion should not gladly recognize and avow. But we are at a loss to know on what grounds the above assertions are made by the Editor of *The Popular Science Monthly*. Perhaps it is in esoteric discoveries, delivered to a select few of his admirers, that Mr. Spencer has "reasoned out" the aforesaid "foundations" and "sought to show" the pre-eminent absoluteness and reality of the 'Infinite and Eternal Spirit,' and Dr. Youmans's statements may have been made on the basis of what he has personally been privileged to hear of these discoveries. Thus the writer of these lines was once informed by an admirer of Mr. Spencer's, who had recently come from a personal interview with the philosopher, that the latter believed in "a God"—*supposing, not without a good deal of reason, that this would be a piece of news to one who knew of Mr. Spencer and his opinions only through his published writings.*

*It is in the latter way, only, that Mr. Spencer is known to the general public.* We, for our part, cannot claim for ourselves familiarity with every line which Mr. Spencer has ever written. But we have studied with great care and with great interest, what we supposed to be Mr. Spencer's of the redistribution of matter and motion. Some of these phenomena have indeed a *mysterious "obverse"*

most important philosophical works, and we do not remember any where to have noticed any evidence of concern on the author's part to prove the existence of an "Infinite and Eternal Spirit." On the contrary, we are every where forbidden by him to regard the Infinite and Eternal, or the Absolute, as either Spirit or matter. Both of these "antithetical conceptions" are held to be purely finite, relative, phenomenal. The absolute is simply "the unknown reality which underlies both," (see *First Principles*, last sentence of the book, *et passim*.) The absolute we are constantly reminded is "wholly unknowable." It is neither Infinite and Eternal Spirit, nor Infinite and Eternal Matter, but simply an altogether indefinable and incognizable somewhat. "That through which all things exist" is in Mr. Spencer's language, "The Unknowable."

The Unknowable is further held to manifest itself to us only as an "inscrutable force" whose operation is exclusively confined to the evolutionary and mechanical "redistribution of matter and motion." Since this operation takes place under the form of rule or law, it is held to conflict with, and render impossible, the supposed "free will," and hence the truly *spiritual nature* of man.

The case is therefore as follows: That there is an absolute reality, we are held to know through "a dim" or wholly "indefinite consciousness," which is called the "raw material of mind," but which utterly refuses to be grasped, defined, or known. The "Infinite Something," which is thus demonstrated for us, is, so far as our definite knowledge extends, and hence practically, an "Infinite Nothing." Strictly known to us are only phenomena aspect, which we term spiritual, ideal, or mental. But no scientific interpretation of these is possible, no knowledge proper is possible concerning them, except so far as they are reducible, directly or proximately, to terms of the redistribution of matter and motion in physiological processes. All our definite knowledge, therefore, is both in its data and its substance, exclusively physical and materialistic, and even the "indefinite consciousness," by which we are held to be assured that an Absolute Something exists, in as regards both its subject and object, also physical; it is certainly not spiritual.

Now, if God, provided he exist, is necessarily a spirit; if man, as the subject of religious emotions and relations, must also be a free spirit; and if, as is the case, there is found in Mr. Spencer's philosophy *no recognition of either God or man as a spirit*, then it is obvious that much ground is given by Mr. Spencer for the supposition that his doctrines—considered *per se*, or independently of their author's intentions—are *virtually atheistic and anti-religious*, and those who honestly entertain this supposition are entitled to be met, not simply with a vigorous *assertion* that they are in error, but with a dispassionate and objective demonstration that they are so.

The whole basis of Mr. Spencer's theory of knowledge is, as is well known, sensational and physical. From such a basis it is and has always been found impossible to rise to the recognition of the absolute as spirit, or man as spirit, or to *comprehend religion otherwise than as a necessary historic incident in the development of ideas*. But the whole basis of human knowledge is not sensational and physical. Free religion implies this, and the grander historic forms of philosophy demonstrate it. The *pre-eminent* intention of knowledge in physical science is indeed sense. The attempt to make this criterion universal leads necessarily to agnosticism with reference to the non-sensible (the Spiritual, Living and Powerful). But it is not *science* which dictates this attempt, and so *Mr. Spencer's agnosticism is not to be charged to science*. The rather, it is due to a purely arbitrary determination on his part, supported, it is true, by the influence of a conspicuous line of predecessors in the history of British speculation. The fact that many theologians have been equally—and some of them—*e. g.*, William of Ockham—even more absurdly agnostic than

he, is not to Mr. Spencer's credit, but to the theologians' discredit. Besides, the agnostic theologians have generally made vigorous affirmation, on the authority of the heart, of that which to their heads was inscrutable. They have, like Kant, practically affirmed that which seems theoretically incomprehensible. However, all this belongs to the sadder side of the history of human thought. Philosophy and theology have existed and still exist in larger, more positive, and more fruitful forms, founded on a completer science of knowledge, which recognizes the spiritual factor in knowledge, or the knowing agent, and so, necessarily, the spiritual nature in the absolute object of knowledge or God.

We say, then, that Mr. Spencer is by no means to be charged with intentional atheism or irreligion. To theism and religion he gives all the meaning which it is possible for him to give them on the basis of that physico-scientific theory of knowledge, which he sincerely believes to be the only possible one. But this meaning really falls absolutely short of meeting the actual requirements of theistic doctrine and living religion. And Mr. Spencer's doctrine in this regard is not that of science, whether "popular" or otherwise, but of a highly artificial and arbitrary "philosophy." It has no more necessary relation to the doctrine of evolution than to the doctrine of gravitation, both of which have been and are (in some form) unquestioningly held by many leaders in spiritualistic or positive (*vs.* agnostic) philosophy..

The dissemination of the eminently valuable results of Mr. Spencer's scientific labors is certainly in place in a *Popular Science Monthly*. But with what special propriety such a periodical should also be made the peculiar vehicle for the promulgation of his extra-scientific *philosophy* it is hard to see. It is not that we would have a line, which Mr. Spencer has written, suppressed or kept from the knowledge of the world. But regard for the honor and purity of \*science, to mention no other consideration, is enough to make one ardently wish that it should not be constructively put forward as sponsor for doctrines whose basis is only quasi-scientific, and which, in truth, belong to another domain—the domain of philosophical inquiry.—GEORGE S. MORRIS, *Professor of Philosophy, University of Michigan; and Lecturer in the Johns Hopkins University*.

## THE HOLLAND HYDROGEN FIRE APPARATUS.

No little interest has been excited during the past year, both in the scientific and practical world, by the remarkable development of results from the Water Gas Apparatus of Dr. Charles Holland, in an ordinary locomotive, as reported by a careful and disinterested observer, through the daily press, and subsequently discussed from a scientific point of view in this journal.

A review of the subject, which has lost none of its importance in the light of further experience and deliberation, will be timely and interesting at the present date.

At Flatbush, the apparatus was placed in the fire-box or furnace of a large (forty-ton) passenger locomotive, of the usual coal-burning pattern, with 16x24 inch cylinders, 5-feet 2-inch driving wheels, and a boiler 23 feet long. In place of the ordinary grate bars are laid three hollow bars or pipes the length of the furnace (8 feet), and from each side of each pipe rise burner-tips at short intervals, making 352 in all. On these pipe-bars, as sleepers, is laid a floor of iron plates studded with open thimbles, through which the 352 burner tips rise to within half an inch of their openings. Over the first 44 burners, next the door, are set four retorts—heavy, hollow blocks of iron—in a row. Two of these retorts receive naphtha, and two water or steam, through separate pipes, and when heated, unite and discharge their vapors through connecting pipes into the pipe bars under the iron floor, and thence through the 352 burners.

The observations at present available enable us merely to compare the firing-up of the same locomotive to the same pressure under substantially equivalent conditions,

\* By "science" we mean, in accordance with the now prevalent usage, the mathematico-physical or descriptive science of sensible *phenomena*.