Huxley on the Physical Basis of Life. Professor Huxley has an important and interesting paper in the Fortnightly Review, from

Mr. Huxley begins by admitting that, when aret apprehended, such a doctrine as his ap-pears almost shocking to common sense. What community of faculty can there be between the brightly colored lichen, which so nearly resembles a mere mineral incrustation of the bare rock on which it grows, and the painter, te whom it is instinct with beauty, or the botanist, whom it feeds with knowledge? If we regard substance, or material composition, what hidden bond can connect the flower which a girl wears in her hair and the blood which courses through her youthful veins? or what is there in common between the dense and resisting mass of the oak, or the strong fabric of the tortoise, and those broad disks of glassy jelly which may be seen pulsating through the waters of a calm sea, but which drain away to mere films in the hand which raises them out of their element? Such objections as these must arise in the mind of every one who ponders, for the first time, upon the conception of a single physical basis of life underlying all the diversities of vital existence; but Mr. Huxley proposes to demonstrate that a threefold unity-namely, a unity of form, and a unity of substantial composition-does pervade the whole living

To illustrate his case, Mr. Huxley goes to the common nettle:-

You are doubtless aware that the common nettie owes its stinging property to the innu-merable stiff and needle-like, though ex-quisitely delicate, hairs which cover its surface. £ach stinging needle tapers from a broad to a stender summit, which, though rounded at the end, is of such microscopic fineness that it readily penetrates, and breaks off in, the skin. The whole hair consists of a very delicate outer case of wood, closely applied to the inner surface of which is a layer of semi-fluid matter, full of innumerable granules of extreme minuteness. This semi-fluid lining is protoplasm, which thus constitutes a kind of bag, full of a limpid liquid, and roughly corresponding in form with the interior of the hair which it fills. When viewed with a sufficiently high magnifying power, the protoplasmic layer of the nettle hair is seen to be in a condition of unceasing activity. Local contractions of the whole thickness of its substance pass slowly and gradually from point to point, and gave rise to the appearance of progressive waves, just as the bending of successive stalks of corn by a breeze produces the apparent billows of a corn-field. But in addition to these movements, and independently of them, the granules corn-field. But in addition to these move-ments, and independently of them, the granules are driven, in relatively rapid streams, through channels in the protoplasm which seem to have a considerable amount of persistence. Most commonly, the currents in adjacent parts of the protoplasm take similar directions; and, thus, there is a general stream up one side of the bair and down the other. But this does not prevent the existence of partial currents which take different routes; and, sometimes, trains of granules may be seen coursing swiftly trains of grapules may be seen coursing swiftly in opposite directions, within a twenty-thou-sandth of an inch of one another; while, occasionally, opposite streams come into direct collision, and, after a longer or shorter struggle, one predominates. . . The possible complexity of many other organic forms, seemingly plexity of many other organic forms, seemingly as simple as the protoplasm of the nettle, dawns upon one; and the comparison of such a protoplasm to a body with an internal circulation, which has been put forward by an eminent physiologist, loses much of its startling character.

The acts of all living things are fundamentally one. Is any such unity predicable of their forms? Let us seek in easily verified facts for a reply to this question. If a drop of blood be drawn by pricking one's finger, and viewed with proper presentions drop of blood be drawn by pricking one's finger, and viewed with proper precautions and under a sufficiently high microscopic power, there will be seen among the innumerable multitude of little, circular discoidal bodies, or corpuscies, which float in it and give it its color, a comparatively small number of coloriess corpuscies, of somewhat larger size and very irregular shape If the drop of blood be kept at the temperature of the body, these coloriess corpuscies will be seen to exhibit a marvelious activity, changing their forms with great rapidity, drawing in and thrusting out prolongations of their substance, and creeping about as if they substance, and creeping about as if they independent organisms. The substance which is thus active is a mass of protoplasm, and its activity differs in detail, rather than in principle, from that of the protoplasm of the nettle. A nucleated mass of protoplasm turns out to be what may be termed the structural unit of the human body. As a matter of fact, the body, in its earliest state, is a mere multiple of such units; and in its perfect condition it is a multiple of such units; and in its perfect condition it is a multiple of such units. dition, it is a multiple of such units, variously modified.

But does the formula which expresses the

But does the formula which expresses the essential structural character of the highest shimal cover all the rest, as the statement of its powers and faculties covered that of all others? Very nearly. Beast and fowl, reptlie and fish, moliusk, worm, and polype, are all composed of structural units of the same character, namely, masses of protaplasm with a nucleus. There are sunity very low animals, each of which, structurally, is a mere colorless blood-corpuscie, leading an independent life. But, at the very bottom of the animal scale, even this simplicity becomes simplified and even this simplicity becomes simplified and all the phenomena of life are manifested by a particle of protoplasm without a nucleus.

And what has been said of the animal world is no less true of plants. Traced back to its earliest state, the nettle arises as the man does, in a particle of pucketed protoplasm.

earliest state, the nettie arises as the man does, in a particle of nucleated protoplasm. And in the lowest plants, as in the lowest animals, a single mass of such protoplasm may constitute the whole plant, or the protoplasm may exist without a nucleus.

Under these circumstances it may well be asked, how is one mass of non nucleated pretoplasm to be distinguished from another? Why call one "plant" and the other "animal?" The only reply is that, so far as form is concerned, plants and animals are not separable, and that, in many cases, it is a mere matter of convention whether we call a given organism and that, in many cases, it is a mere matter of convention whether we call a given organism an animal or a plant. There is a living body called Æthalium septicum, which appears upon desaying vegetable substances, and in one of its forms is common upon the surface of tan pits. In this condition it is, to all intents and purposes, a fungus, and formedly was always regarded as such; but the remarkable investigations of De Bary have shown that, in another condition, the Æthalium is an actively locomotive creature, and takes in solid

tively locomotive creature, and takes in solid matters, upon which, apparently, it feeds, thus exhibiting the most characteristic feature of animality. Is this a plant, or is it an animal? Is it both, or is it neither?

Mr. Huxley declares at this point that protoplasm, simple or nucleated, is the formal basis of all life. It is the clay of the potter, which, bake it and paint it as you will, remains clay, separated by artifice and not by nature, from the commonest brick or sundried clod. All living powers are cognate, and all living forms are fundamentally of one character.

The researches of the chemist have revealed a no less striking uniformity of material com-

position in living matter: -

In perfect strictness, it is true that chemical investigation can tell us little or nothing, directly, of the composition of living matter, inaspuch as such matter must needs die in the act of analysis—and upon this very obvious ground, objections, which I confess seem to me to be somewhat frivolous, have been raised to the drawing of any conclusions whatever respecting the composition of actually living matter from that of the dead matter of life, which alone is accessible to us. But objectors of this class do not seem to reflect that it is also, in strictness, true that we knew nothing about the composition of any body whatever as it is. The statetrue that we knew nothing about the composi-tion of any body whatever, as it is. The state-ment that a crystal of cale-spar consists of car-bonate of lime is quite true, if we only mean that, by appropriate processes, it may be re-solved into carbonic acid and quizklime. If you pass the same carbonic acid over the very quicklime thus obtained, you will obtain car-bonate of lime again; but it will not be cale-spar, nor anything like it. Can it, therefore, be said that chemical analysis teaches nothing about the chemical composition of cale spar? about the chemical composition of cale spar?
Such a statement would be absurd; but it is
hardly more so than the talk one occasionally
hears about the uselessness of applying results
of chemical analysis to the living bodies which

have yielded them.

One fact, at any rate, is out of reach of such refinements, and this is, that all the forms of protoplasm which have yet been examined contain the four elements, carbon, hydrogen, exygen, and nitrogen in very complex union, and that they behave similarly towards several resgents. To this complex combination,

the nature of which has never been determined with exactness, the name of Protein has been applied. And if we use this term with such caution as may properly arise out of our comparative ignorance of the things for which it stands, it may be truly said that all protoplasm is proteinaceous; or, as the white, or albumen, of an egg is one of the commonest examples of a nearly pure protein matter, we may say that all living matter is more or less albuminoid.

albuminoid.

And now, what is the ultimate fate, and what the origin, of the matter of life? Is it, as some of the older naturalists supposed, diffused throughout the universe in molecules, which are indestructible and unchangeable in themselves; but, in encless transmigration, unite in innumerable permutations, into the diversified forms of life we know? Or, is the matter of life composed of ordinary matter, differing from it only in the manner in which its atoms are aggregated? Is it built up of ordinary matter, and again resolved into ordinary matter when its work is done? Modern science does not hesliate a moment between these alternatives, Physiology writes over the portals of life— Physiology writes over the portals of life-

"Detemur morti nos nostraque," with a profounder meaning than the Roman poet attached to that melancholy line. Under whatever disguise it takes refuge, whether fungus or oak, worm or man, the living pro-toplasm not only ultimately dies and is resolved into its mineral and lifeless constituents, but is always dying, and, strange as the paradox may sound, could not live unless it died.

All work implies waste, and the work of life results, directly or indirectly, in the work of protoplasm. Every word uttered by a speaker costs him some physical loss, and, in the strictest sense, he burns that others may have light-so much eloquence, so much of his body resolved into carbonic acid, water, and urea. It is clear that this process of expenditure cannot go on forever. But,

happily, there is also a process of renewal:-For example, this present lecture, whatever its intellectual worth to you, has a certain its intellectual worth to you, has a certain physical value to me, which is, conceivably, expressible by the number of grains of protoplasm and other bodily substance wasted in maintaining my-vital processes during its deil very. By and by I shall probably have recourse to the substance commonly called mutton, for the purpose of stretching it back to its original size. Now this mutton was once the living protoplasm, more or less modified, of another animal—a sheep. As I shall eat it, it is the same matter altered, not only by death, but but by exposure to sundry artificial operations in the process of cooking. But these changes, whatever be their extent, have not rendered it incompetent to resume its old funcchanges, whatever be their extent, have not rendered it incompetent to resume its oid functions as matter of life. A singular inward laboratory, which I possess, will dissolve a certain portion of the mcdified protoplasm, the solution so formed will pass into my veins; and the subtle influences to which it will then be subjected will convert the dead protoplasm into living protoplasm, and transubstantiate sheep into man. Nor is this all. If digestion were a thing to be trifled with, I might sup upon lobster, and the matter of life of the crustacean would undergo the same wonderful metamorphosis into humanity. And were I would undergo the same wonderful metamorphosis into humanity. And were I to return to my own place by sea, and undergo shipwreck, the crustacea might, and probably would, return the compilment, and demonstrate our common nature by turning my protoplasm into living lobster. Or, if nothing better were to be had, I might supply my wants with mere bread, and I should find the protoplasm of the wheat-plant to be convertible into man, with no more trouble than that of the sheep, and with far less, I fancy, than that of the lobster. Hence it appears to be a matter of no great moment what animal, or what plant, I say under contribution for protoplasm, and the fact speaks volumes for the general identity of that substance in all living beings. I share this catholicity of assimilation with other animals, all of which, so far as we know, could thrive equally well on the protowith other animals, all of which, so far as we know, could thrive equally well on the protoplasm of any of their fellows, or of any plant; but here the assimilative powers of the animal world cease. A solution of smelling-sails in water, with an infinitesimal proportion of some other sailne matters, contains all the accountary bodies which entering a second contains a second con tains all the elementary bodies which enter into the composition of protoplasm; but, as I need hardly say, a nogshead of that fluid would not keep a hungry man from starving, nor would it save any animal whatever from a like would it save any animal whatever from a like fate. An animal cannot make protoplasm, but must take it ready made from some other animal, or some plant—the animal's nighest feat of constructive chemistry being to convert dead protoplasm into that living matter of life which is appropriated to itself.

Therefore, in steking for the origin of protoplasm, we must eventually turn to the very plasm, we must eventually turn to the vege-table world. The fluid containing carbonic acid, water, and ammonia, which offers such a Barmecide feast to the animal, is a table richly spread to multitudes of plants; and, with a due supply of only such materials, many a plant will not only maintain itself in vigor, but

grow and multiply until it has increased a million fold, or a million million-fold, the quantity of protoplasm which it originally possessed; in this way building up the matter of life, to an indefinite extent, from the common matter of the universe.

But it will be observed that the existence But it will be observed that the existence of the matter of life depends on the pre existence of certain compounds, namely, carbonic acid, water, and ammonia Withdraw any one of these three from the world, and all vital phenomena come to an end. They are related to the protoplasm of the plant, as the protoplasm of the plant, as the protoplasm of the plant is to that of the animal. Carbon, hydrogen, oxygen, and nitrogen are all lifeless bodies. Of these, carbon and hydrogen unite in certain proportions and under certain conditions, to give rise to carbonic acid; hydrogen and oxygen produce water; nitrogen and hydrogen give rise to ammonia. These new compounds, like the elementary bodies of which they are composed, are lifeless. But when they are brought together, under certain conditions they give rise to the still more complex body, protoplasm, gether, under certain conditions they give rise to the still more complex body, protoplasm, and this protoplasm exhibits the phenomena of life. I see no break in the series of steps in molecular compilcation, and I am unable to understand why the language which is applicable to any one term of the series may not be used to any of the others. We think fit to call different kinds of matter carbon, oxygen, hydrogen, and nitrogen, and to speak of the various lowers and activities of these substances as the properties of the matter of which they are composed. When hydrogen and oxygen are mixed in a certain proportion, and an electric spark is passed through them, they disappear, and a quantity of water, equal in weight to the sum of their weights, appears in their place. The re is not the slightest parity between the passive and active powers of the water and those of the oxygen and hydrogen which have given rise to it. At 32 deg. Fahrenheit, and iar below that temperature, oxygen and hydrogen are electic gaseous bodies, whose particles tend to rush away from one another with great force. and bydrogen are elastic gaseous bodies, whose particles tend to rush away from one another with great force. Water at the same temperature is a strong though britle solid, whose particles tend to cohere into definite geometrical shapes, and sometimes build up frosty imitations of the most complex forms of vegetable foliage. Nevertheless we call these, and many other strange phenomena, the properties of the water, and we do not hesitate to believe that, in some way or shother, they result from the properties of the component elements of the water. We do not assume that a something called "squosity" entered into and took possession of the oxide of hydrogen as soon as it session of the oxide of hydrogen as soon as it was formed, and then guided the aqueous particles to shelr places in the facets of the

crystal, or amongst the leadlets of the hour-frost. Is the case in any way changed when carbonic acid, water, and ammonia disappear, and in their place under the influence of pre-existing living protoplasm, an equivalent weight of the matter of life makes its appear-ance? ance?
It is true that there is no sort of parity It is true that there is no sort of parity between the projecties of the components and the properties of the resultant, but neither was there in the case of the water. It is also true that what I have spoken of as the influence of pre-existing living matter is something quite unintelligible; but does anybody quite comprehend the modus operandi of an electric park, which traverses a mixture of oxygen and hydrogen.

which traverses a mixture of oxygen and hydrogen?

What justification is there, then, for the assumption of the existence in the living matter of a something which has no representative or correlative in the not living matter which gave rise to 1:? What better philosophical status has "vi.ality" than "aquosity?" And why should "vitality" hope for a better fate then the other "itys" which have disappeared since Martinus Scriblerus accounted for the operation of the meat-jack by its inherent the operation of the meat-jack by its inherent "meat reasting quality," and scorned the "materialism" of those who explained the turning of the spit by a certain mechanism worked by the draught of the chimney?

And now, says Mr. Huxley, after still fur-

ther enforcing his view of the facts:-I bid you beware that, in accepting these conclusions, you are placing your feet on the first rung of a ladder which, in most people's estimation, is the reverse of Jacob's, and leads to the aptipodes of heaven. It may seem a small

thirg to admit that the duil vital actions of a fungus, or a formulalifer, are the properties of their protoplasm, and are the direct results of the nature of the matter of which they are composed. But if, as I have endeavored to prove to you, their protoplasm is essentially identical with, and most readily converted into, that of any animal, I can discover no logical halting-place between the admission that such is the case and the further concession that such is the case and the further concession that such is the case and the further concession that such is the the result of the molecular forces of the protoplism which displays it. And if so, it must be true, in the same sense and to the same extent, that the thoughts to which I am now giving utterance, and your thoughts regarding them, are the expression of molecular casages in that matter of life which is the source of our other vital phenomens.

in that matter of life which is the source of our other vital phenomens.

Past experience leads me to be tolerably certain that, when the propositions I have just placed before you are accessiole to public comment and criticism, they will be condemned by many zealous persons, and perhaps by some few of the wise and thoughtful. I should not wonder if "gross and materialism" were the mildest phrase applied to them in certain quarters. And most undoubtedly the terms of the propositions are distinctly materialistic. propositions are distinctly materialistic. Nevertheless two things are certain: the one, that I hold the statements to be substantially true; the other, that I, individually, am no materialist, but, on the contrary, believe materialism to involve grave philosophical egror. What, he says further on-

What is the difference between the conception of life as the product of a certain disposition of material molecules, and the old notion of an Archicus governing and directing blind matter within each living body, except this—that here, as elsewhere, matter and law have devoured spirit and spontaniety? And as surely as every future grows can of past and gressel. as every future grows cut of past and present, so will the physiology of the future gradually extend the realm of matter and law until it is co-extensive with knowledge, with feeling, and with action. The consciousness of this great truth weighs like a nightmare, I believe, upon many of the best minds of these days. They want to what they conceive to be the progress of many of the best minds of these days. They watch what they conceive to be the progress of materialism, in such fear and powerless anger as a savage feels, when, during an ectipse, the great shadow creeps over the face of the sun. Theadvancing tide of matter threatens to drown their souls; the tightening grasp of law impedes their freedom; they are alarmed lest man's moral nature be debased by the increase of bis wisdom. * * But, after all, what do we know of this terrible "matter," except as a name for the unknown and hypothetical cause of states of our own consciousness? And what do we know of that "spirit" over whose threatened extinction by matter a great lamenthreatened extinction by matter a great lamen-tation is arising, like that which was heard at the death of Pan, except that it is also a name for an unknown and hypothetical cause, or condition, of states of consciousness? In other words, matter and spirit are but names for the imsginary substrata of groups of natural phenomens.

phenomens.

In itself it is of little moment whether we express the phenomena of matter in terms of spirit, or the phenomena of spirit in terms of matter; matter may be regarded as a form of thought thought may be regarded as a property of matter—each statement has a certain relative truth. But with a view to the progress of science, the materialistic terminology is in every way to be preferred. For it connects thought with the other phenomena of the universe, and suggests inquiry into the nature of these physical conditions or concenitants of verse, and suggests inquiry into the nature of those physical conditions, or concomitants of thought, which are more or less accessible to us, and a knowledge of which may, in future, help us to exercise the same kind of control over the world of thought as we already possess in respect of the material world; whereas, the aiternative, or spiritualistic, terminology is utterly barren, and leads to nothing but obscurity and confusion of ideas.

Thus there can be little doubt that the further science advances the more extensively and consistently will the phenomena of nature be represented by materialistic formulæ and symbols.

symbols. But the man of science, who, forgetting the limits of philosophical inquiry, slides from these formulæ and symbols into what is commonly understood by materialism, seems to me to place himself on a level with the mathematician who should mistake the x's and y's with which he works his problems for real entities—and with this further disadvantage, as compared with the mathematician, that the blunders of the latter are of no practical consequence, while the errors of systematic materialism may paralyze the energies and destroy rialism may paralyze the energies and destroy the beauty of a life.

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Bix Per Cent. Bonds, (P.
R. R. guarantee).

30,000 State of Tennessee Five Per
Cent. Loan.

7,000 State of Tennessee Five Per
Cent. Loan.

15,000 Germantown Gas Co., principal and interest guaranteed by City of Philad'a. 136,800.00 50,000.00 211,375 06 128,594-00 51,500.00 20,200 00 20,625:00

21,000-00 5,031-25 15,000:00 11,300 00

207,900:00 Market value, \$1,130,325.25 Cost, \$1,093,604.26. \$1,109,900 Par.

40,178.88 pany...

Stock and scrip of sundry corporations, \$3156. Estimated value....

Cash in bank......\$116 150:08

Cash in drawer...........\$12:65

116,563 78 \$1,647,367-80

1,813.00

Bamuel E. Stokes, Thomas C. Hand,
John C. Davis,
James C. Hand,
Theophilus Paulding,
Joseph H. Seal,
Hugh Craig,
John R. Penrose,
Jacob P. Jones,
James Traquair,
Edward Darlington, Henry Sloan, William C. Ludwig, George G. Lelper, Henry C. Daliett, Jr., John D. Taylor, George W. Bernadou, William G. Boulton, James Traquair,
Edward Darlington,
H. Jones Brooke,
James B. McFarland,
Edward Lafourcade,
Joshua P. Eyre,
JOHN C. DAVIS, Vice-President,
HENRY BALL, Assistant Secretary,
10 6

1829-CHARTER PERPETUAL. Franklin Fire Insurance Co.

Nos. 485 and 487 CHESNUT STREET, #2,603,740.09.

ACCEUED SURPLUS I,018,592-59 I,018,592-59 INCOME FOR 1887 UNSETTLED CLAIMS. \$88,693-22 \$850,000-00,

85 500,000.
Perpetual and Temporary Policies on Liberal Term

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Daniel Haddock, Jr.,
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