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Contributors

Croll, James, 1821-1890.
Cox, Edward W. 1809-1879.
Royal College of Surgeons of England

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PSYCHOLOGY PROVED

BY

PHYSICAL SCIENCE.

(*Abstracted from a Paper by JAMES CROLL, ESQ., F.R.S., President of the Geological Survey of Scotland. Read to the Psychological Society of Great Britain, Thursday, March 15, 1877, by the PRESIDENT.*)

MR. JAMES CROLL, of Edinburgh, one of our distinguished Honorary Members, is desirous to submit to the consideration of the Psychological Society his theory of "What determines Molecular Motion," so far as it bears upon the great Science to the advancement of which this Society is devoted. But I regret to say that he is labouring under a physical infirmity of sight, which prevents him from writing, as otherwise he would have preferred to do. In these circumstances he has supplied me with materials for presenting in a condensed form the very important conclusions at which he has arrived and the clear and sustained argument by which he supports them. His profound and original views were originally given to the world in a paper which

appeared in the *Philosophical Magazine* in the year 1872. But in this essay the bearing of the question upon Physics is mainly treated of. That portion of it, important as it is, possesses but a secondary interest for this Society and will require no more reference than will be sufficient to make the psychological aspect of the subject intelligible to the members. Hence it is here much abbreviated and a portion of the language is necessarily my own; but I hope to present a faithful outline of his argument.

The laws of Molecular Motion are now generally accepted as being the ultimate problem of the Universe. Molecular Physics is the Science upon which all the other Physical Sciences will ultimately converge.

Molecular Physics resolve themselves into two great problems.

First, what is the constitution of the ultimate atoms that make molecules and of the molecules that make matter?—for, be it observed, a molecule is only an aggregation of atoms.

Second, what are the laws of their motion?

But a grand fundamental problem lies behind these two problems, to which attention will be directed presently.

The solution of the first problem—what is the ultimate constitution of matter?—has not even been conjectured, much less arrived at. But some facts leading to it are now generally accepted as proved. The molecule is *not* the ultimate particle. There are atoms of which molecules are composed. Molecules made up of atoms combined in different proportions doubtless present the same diversities of shape and character as do the various combinations of molecules of which that we call “matter” is constructed. Our senses are fitted to perceive only that combination of atoms which constitutes molecules, and we call the things so constructed “matter.” Beyond all doubt there are infinite varieties of structure formed of other combinations

of atoms than that which forms "matter," and of whose existence, being wholly imperceptible to any sense, we are and must be entirely unconscious, at least so long as we can obtain perceptions of the external world through the medium of the senses alone. If ever there be for us, here or hereafter, a condition in which we can perceive some or all of the non-molecular combinations of atoms, then a wholly new and strange existence—a new world, in fact—would be opened to us here, in our very dwelling place, all around us and above us.

The second problem, however, is that which has most invited the investigation of Mr. CROLL, namely, what are the motions of molecules? Upon this I quote Mr. CROLL himself.

The second problem, we have seen, refers not to the nature of the molecule, but to its motions. Now in regard to all physical change or motion, no matter what the nature of that change or motion may be, there are at the very outset two fundamental questions which suggest themselves: (1) What produces the change—causes motion? (2) What determines or directs it?

In regard to the first question, there is no diversity of opinion. All agree that what produces change or causes motion is Force. The second question, however, viz. what determines or directs the motion, is not so easily answered. This question is not only the more difficult of the two, but also by far the more important.

All physicists agree that what is called Physical Law is just the expression of the manner in which forces act in the production of their effects, or "the paths along which they travel to their particular results," as Mr. Lewes expresses it. (a) In the production of all physical phenomena we have, therefore, two distinct elements, viz., force, and the way or manner in which force acts—force, and the paths along which it travels, so to speak—or, in other words still, Force and the Laws of Force.

One of the most important results of modern physical inquiry has

(a) Comte's Philosophy of the Sciences. By G. H. Lewes. Section V.

been to show that the various phenomena of Light, Heat, Electricity, &c., are but different modifications in the action of the same forces. When the forces take one path, we have Light; taking another path, we have Heat; another produces Electricity, and so on. Now it will be observed that the fundamental question is not, what is the particular force in action, or upon what does its exertion depend, but rather what is it that causes the force to act in the particular manner in which it does act? In other words, what determines the paths along which it acts? Physical phenomena are produced in general by the motion of the molecules or of the atoms of bodies; now the great question is not simply what produces the motion, but what produces the particular kind of motion? It is not what gives *existence* to the motion, but what *determines its direction*? This is evident, because the particular phenomenon, regarding which our inquiries are concerned, does not directly depend upon the mere existence of the motion, but upon its special direction or determination. The same exertion of force which produces one phenomenon would probably produce any other phenomenon, were determination in the proper direction given to it. It is the determination of the force which accounts for the particular phenomenon; the mere exertion of force may be supposed to be the same in all phenomena.

The first proposition is, therefore, "That the *production* of Motion and the *determination* of motion are absolutely and essentially different."

By determination of motion he means *its direction to a special end*.

Force may produce motion—but force does not determine the direction of that motion. All the motion that goes to inorganic or to organic structure is a definite motion. It is directed to a specific purpose. Say that it acts in obedience to law. We mean by this only that the force that causes the particular motion has been determined by something else. But that determining force must have been itself determined. Thence Mr. CROLL deduces his second proposition.

(2.) *The action of a force cannot be determined by a force, nor can motion be determined by motion.*

This may be demonstrated thus. The act that directed the act must exist in time and space, and bear a certain relationship to time and space, and something must have given it that relation. If it be contended that a prior act directed this act, that prior act must have been itself directed, and so infinitely.

It may be proved in like manner that motion cannot *determine* motion. It can impart motion, but it cannot *direct the motion* to a specific purpose, as, for instance, to construct a brain, with its millions of fibres.

Hence the mystery is, not what are the forces that *move* atoms and molecules, but what is it that *guides* and *directs* the motions of atoms to the formation of molecules, and of molecules to the formation of organic structure. When an atom or a molecule is set in motion, the number of directions in which force may move it is infinite. But out of this infinite number of different paths open to it, what is it that directs the force to choose the right path—that is to say—the path to the definite purpose?

Here, again, I cite Mr. CROLL himself:

It is asserted that force is self-directing. This is simply getting into confusion again. What conceivable idea can be attached to a self-directing force? Is force a something which not only acts but determines for itself how and when it shall act? In what conceivable way can force direct its own path? A molecule has to be moved into its proper place in an organic form; a force gives motion to the molecule; but out of the infinite number of possible directions in which the molecule may be moved the force moves it in the right direction. What is that something which thus guides the force? The force guides itself, it is replied. Be it so; but in what way does the force direct or guide itself? What is the nature of that something in virtue of which the force directs its actions? It is supposed that that something belonging to the force which thus guides and directs its action is itself a force? Does the force direct itself by means of a force? if so, then we are back to our old absurdity of a force determining a force. And if this directing something is not a

force, what is it? But if this something is not a force, it follows that there is something else to be known than mere force before we can penetrate the mystery of nature.

Endeavour to conceive of a force directed by a force, and you will find the determination of the force to result, not from the supposed force, but from the *way* in which the actual force acts.

Apply this to the structure of organic form, and what is the result? Says Mr. CROLL:

We have been accustomed to speak of organic forms being built up particle by particle by the play of molecular forces; and probably most of those who know little about science imagine that scientific men attach some clear and definite idea to such a statement. They naturally conclude that the scientific physicist understands in some way or other how, and in what way, these forces may be conceived to build up the structure; and they no doubt would feel surprised were they told, what in reality is the plain truth, that the physicist who uses those terms knows just as little about how the play of forces can build up an organic structure as he does himself. The idea has gained a footing that the thing is done in some way or other by forces: and although in the mean time we cannot comprehend the manner in which it is done, yet we imagine that at some future day all will be plain.

His third proposition is "*That all the Energies and Forces of Nature are notably the same, and differ only in regard to their modes of operation.*"

This proposition he illustrates thus:

This follows as a consequence from the principle of the Conservation of Energy, viz., that the sum total of the energies in nature remains constant, the amount neither being increased nor diminished.

Suppose now that two substances (say, oxygen and hydrogen) combine chemically. Heat is evolved as a consequence. The energy in the form of heat is derived from the energy in the form of chemical combination. The energy which disappears in chemical combination reappears as heat. We have first chemical energy

and then heat; not first annihilation of chemical energy and then creation of heat. The energy which now appears as heat is the self-same energy which previously existed as chemical energy. The energy has only changed its form, and nothing more.

Suppose the heat to be applied to move a machine and to perform mechanical work. What appears as mechanical energy (mechanical motion) disappears as heat; and the energy stored up potentially as work performed, say, in the raising of a weight, is the self-same energy which previously existed as chemical energy and then as heat. The same holds true whatever may be the number of the transformations. Chemical combination will produce an electric current; the electric current will produce magnetism; and the magnetism will produce motion in a machine; and the machine will generate heat or perform work. Here we have the energy assuming in succession five or six different forms. While the particles are combining we call the energy chemical; when the electric current is produced we designate the energy electrical; when magnetism is produced we designate it magnetic: and when the machine is in motion we call it mechanical, and so forth. It is the same energy under all these various forms. The only difference between chemical, electric, magnetic, and heat energy is merely in the mode of operation. The difference lies, therefore, not in the force or energy itself, but in its determinations. If we regard heat, light, electricity, magnetism, chemical action, &c., as but different modes of motion, as they in reality probably are, then the difference between chemical action and heat, or between heat and electricity, or between electricity and magnetism, or between magnetism and mechanical motion, &c., depends wholly on the cause of the determination of motion. The difference does not lie in the mere exertion of force, but in the way or manner in which force is exerted.

Turning to the theories of Life, Mr. CROLL admits frankly that vital force is only one of the physical forces. He says:

Evidently the vital energies of the plant and animal are derived from the chemical affinities of the food and nutriment which they receive. Vital force is chemical force transformed. The same remark holds true of the mechanical and other physical energies of the body. The energy by which the arm is raised or by which the heart beats is derived from the food. Animal heat is derived from chemical combination.

So far he agrees with the Materialists. But at this point he joins issue with them: "Are these forms of energy—some or all of them,—sufficient to account for the phenomena of organic nature and of life?"

He answers the question thus: They are *insufficient*, because they do not account for the *objective idea in nature*. He says:

Whatever may be one's opinions regarding the doctrine of Final Causes and the evidence of design in nature, all must admit the existence of the objective idea in nature. We see everywhere, not only exquisite order and arrangement in the structure of plants and animals, but a unity of plan pervading the whole. We see, in endless complexity, beauty, and simplicity, the most perfect adaptation of means to ends. The advocates of the physical theory are at least bound to show how it is probable that this exquisite arrangement and unity of plan could have been produced by means of chemical and physical agencies.

Let us briefly consider what really has to be explained and accounted for. Take, say, the leaf of a tree. The leaf is not moulded by some external agency into its particular shape, but is built up molecule by molecule. The form and structure of the leaf is the result of the arrangement and disposition of the particles of which it is composed. The thing to be accounted for is not what moves the molecules or particles in its formation, but what guides, directs, or determines the motion of these particles. The leaf could not be formed did not each particle move in the right direction and stop at the proper time and at the proper place. Each molecule occupies its own special position in the leaf; consequently no two molecules in moving to their positions can take the same path. What, then, determines the particular path for each molecule? or rather, what determines the motion of each molecule along its particular path? The mere motion of the molecules is produced by force; but what directs or determines this force to move each particle along its special path? But the mystery is deeper still. Not only are the paths of the molecules different, but they must all be adjusted in relation to one another; for it is to the proper adjustment of the paths that the form of the leaf is due. In other words, the motion of each molecule must be determined according to the objective idea of the leaf.

But the whole tree is built up of molecules, as well as the leaf. The molecules which form the branch must be differently determined from the molecules forming the leaves; and each molecule of the branch must take a path different from all the other molecules of the branch; but the motions of all the molecules must be determined according to the objective idea of the branch. What holds true of one branch holds true of all the other branches; and what holds true of the branches holds equally true of the trunk, and of the roots, and of the whole tree. Each particle must be determined not only in relation to the objective idea of the particular leaf or the particular branch to which it belongs, but in relation to the objective idea of the tree. In the formation of the tree each molecule must move along its special path, but the paths must be so adjusted to one another that a tree shall be the result. But this is not all; the molecules must move and adjust themselves in relation to the idea of a tree of a special kind. The molecules forming, say, an oak tree, must move in relation to one another in a different way from those forming a beech tree or a pine. But however diversified may be the motions of the molecules in the different species of trees, yet, notwithstanding, all must move in relation to the general idea of a tree. And what holds true of trees holds equally true of every form of plant-life on the globe. And what holds true of the vegetable kingdom holds equally true of the animal kingdom. Each plant and each animal has not only its own particular form, but it has the form of the species to which it belongs—and not only this, but the form of the genus to which the species belongs—and not only the form of the genus, but the form of the family, order, class, and kingdom to which the genus belongs.

Natural selection will not explain this objective idea. Mr. DARWIN's theory cannot, from its very nature, explain the mystery of the organic world. He does not trace the *directing cause* of molecular motions. Further:

But there is not merely a unity of plan to be accounted for, but also a unity of purpose. Things in nature are not only related to one another in form, but they stand related as means to ends. And this relationship is as all-pervading as that of form. There is not an object in nature that does not stand in the relationship of a *means* to something as an *end*. And there exists a unity in the ends as well as in the forms. All molecular motions must consequently

have this double relationship of plan and purpose. How, then, is all this order and unity both of plan and purpose in molecular motions to be accounted for?

Mr. CROLL next considers molecular motion in relation to the *forms* of objects. All things in nature are built up, molecule by molecule, through molecular motion. Energy, or force, transports the molecules, but *what determines the position in which they shall be placed?* The form assumed by them is not due to the energy that brings the material, but to the power that directs and determines that energy. The *force* no more regulates the *form* than the labourer who carries the bricks shapes the house. Do chemistry and physics explain this? The Materialists attempt a solution by calling it the vital force, the directing force. Vital force is, they say, the result of the food we eat—a mere chemical product, in fact. The Materialists deny that there exists in organic being any form of energy differing from that to be found in the inorganic world. And it is upon this that Psychology challenges Materialism.

Mr. CROLL then reviews the physical forces especially and shows their insufficiency for organic structure :

Molecular physics has made great advance of late years ; but it has not made much advance in that particular direction which can be of service in explaining how molecular motion in organic nature is determined. It is thought, however, by the advocates of the physical school that, although at present we are unable to explain how organic nature can be built up by the play of the ordinary chemical and physical forces, yet at some future day, when we shall have come to know far more of molecular physics than we do at present, then we may be able to explain the mystery. This is the cherished hope of modern Evolutionists, and of the advocates of the physical theory of life. But it is a mental delusion, a dream which will never be realised. A little consideration might satisfy any one that Chemistry and Physics will never explain the mystery of nature.

And thus he sums up his argument :

It must now be obvious that nothing which can be determined by the comparative anatomist, no biological researches, no microscopic investigations, no considerations regarding natural selection or the survival of the fittest can solve the great problem of nature : for it lies in the background of all such investigations. The problem is molecular. From the hugest plant and animal on the globe down to the smallest organic speck visible under the microscope, all have been built up molecule by molecule ; and the problem is, to explain this molecular process. If one plant or animal differs from another, or the parent from the child, it is because in the building-up process the determinations of the molecular motion were different in the two cases ; and the true and fundamental ground of the difference must be sought for in the cause of the determination of molecular motion. Here in this region the doctrine of natural selection and the struggle for existence can afford no more light on the matter than the fortuitous concourse of atoms and the atomical philosophy of the ancients.

It may be permitted to us to draw the conclusion from this admirable paper.

It almost demonstrates as a fact in Nature and Science that the Universe is not wholly material—probably the material part being the least part of it. It proves scientifically that *spirit*—by which I mean nothing more than *non-molecular being*, affirming nothing whatever what that being is—underlies, surrounds, possibly permeates, all molecular matter—that the forms of life and being are not determined by chance nor by the fortuitous combination of atoms, but are moulded by forces that are not the blind physical forces, but some power with a plan, which determines organic structure and perhaps all mundane structure. Mr. CROLL's paper proves that matter, which is the proper study of the chemists, is not, as the Materialists would have it, the all in all, but that there is *behind the world of matter* and probably underlying it a

cosmos of spirit—a Universe of Soul—whose investigation is the proper province of Psychology. While the Materialists are usefully toiling to learn the laws of those physical forces that mechanically move the dead unconscious matter which alone they recognize, we Psychologists are not less usefully employed in exploring the facts and phenomena of living conscious being, the forces by which it is moved, and that yet greater force which determines the direction of all the forces of nature, and builds up that world of organic and inorganic matter which the Materialists are analysing. We thank them for that good work. We cordially recognize the great service Physical Science is doing. We complain only that Physicists will not be content with labouring in their own province and leaving Psychology to Psychologists, but that, without seeing or knowing aught of its facts and phenomena, they venture to pass judgment upon another branch of science of which they confess themselves wholly ignorant. Psychologists justly complain, not that the Materialists refuse to recognise any other than the material—that is, the molecular—form of being (for this they have a right to do) but that they refuse to hear any evidence or any argument that goes to prove the existence of such a form of being; that they insist upon pronouncing a verdict upon that which they have never seen, nor tried, nor studied, although they would be the first to rebuke the presumption of any Psychologist who, being ignorant of electricity or astronomy, should dare to deny the phenomena they who have seen assert and not content with denial should proclaim those who *have* witnessed them to be fools or rogues. If their conviction be that Man is a mere machine—Soul a myth—future life a fable,—they are welcome to their degrading and despairing creed. Mischievous as it is to society by its annihilation of all hope for

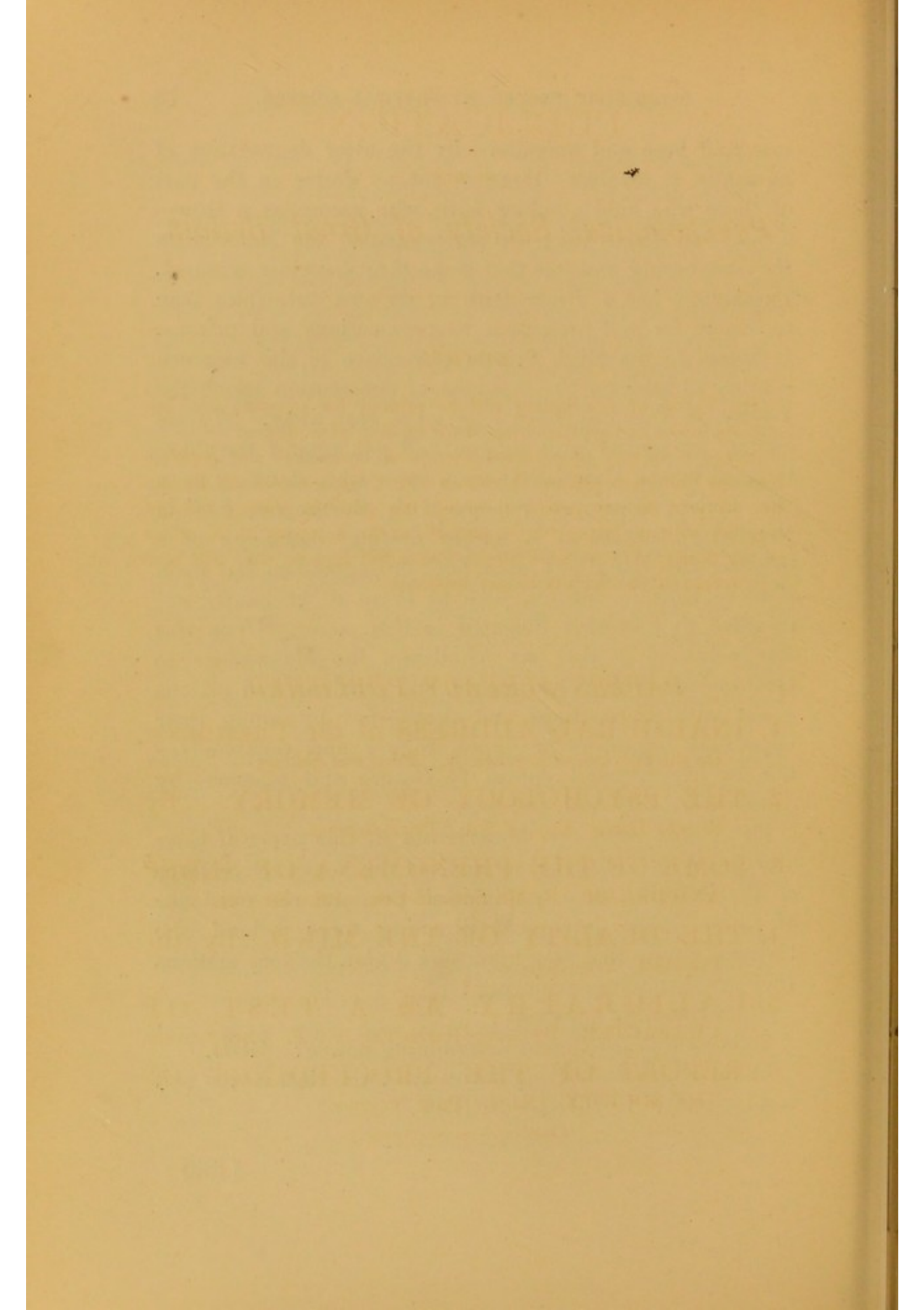
mankind here and hereafter—by the utter degradation of humanity it involves—there is yet no desire on the part of those who hold a nobler faith, who recognise a God—a *Soul*—an *Immortality*—to revive against the Materialists the slumbering statutes that make *their* doctrines criminal. Psychology has a firmer faith in its own principles than to resort for self-protection to prosecutions and prisons. It leaves to the High Priests of Science in this nineteenth century to take up the weapons of persecution which the Priests of Theology have long since cast away. We are content to protest with tongue and pen against the abuse lavished by the Materialists upon those who, standing upon the same platform of Science with themselves, find in Psychology proofs of a higher destiny, dawnings of a brighter day, based not upon faith or dogmatism but upon positive facts in Nature, such as those so brilliantly expounded by a brother Scientist in this paper. Upon this standpoint it is that we challenge the Materialists to combat—not with police courts, and penalties, and prisons—not with prosecutions and abuse—not by calling their opponents impostors or dupes, rogues and vagabonds—but by experimental appeal to Nature and Science—by examination, and trial, and test.

Mr. CROLL asks the Materialists in this paper if their own theory of molecular motion, as the constructive force of the Universe, does not in itself proclaim the existence of some other intelligent directing force behind the Physical Forces that *determines with a plan* the very motions they are themselves exploring?

Then come the questions:

What *is* this Intelligent determining power? GOD.

What is this underlying formative force that moves and moulds matter? SOUL—SPIRIT.



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