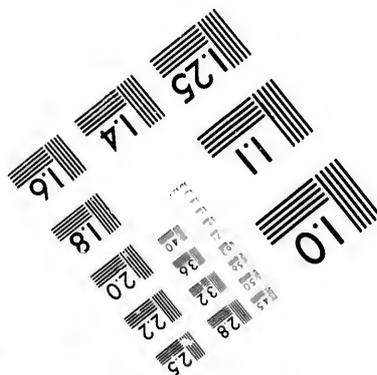
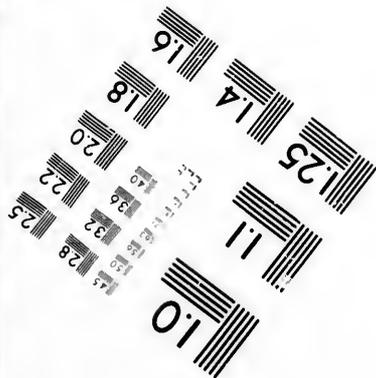
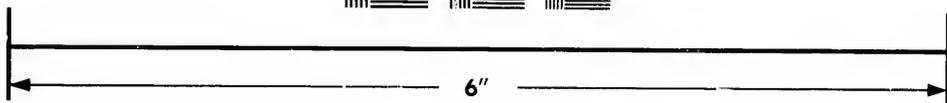
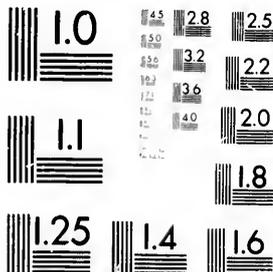


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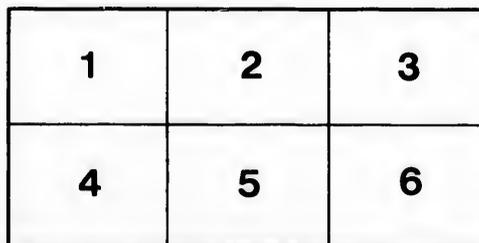
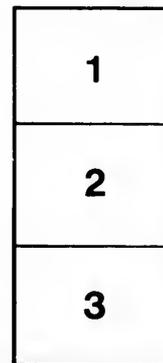
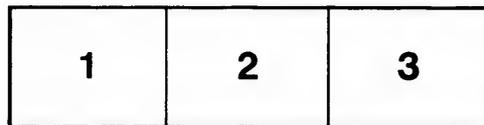
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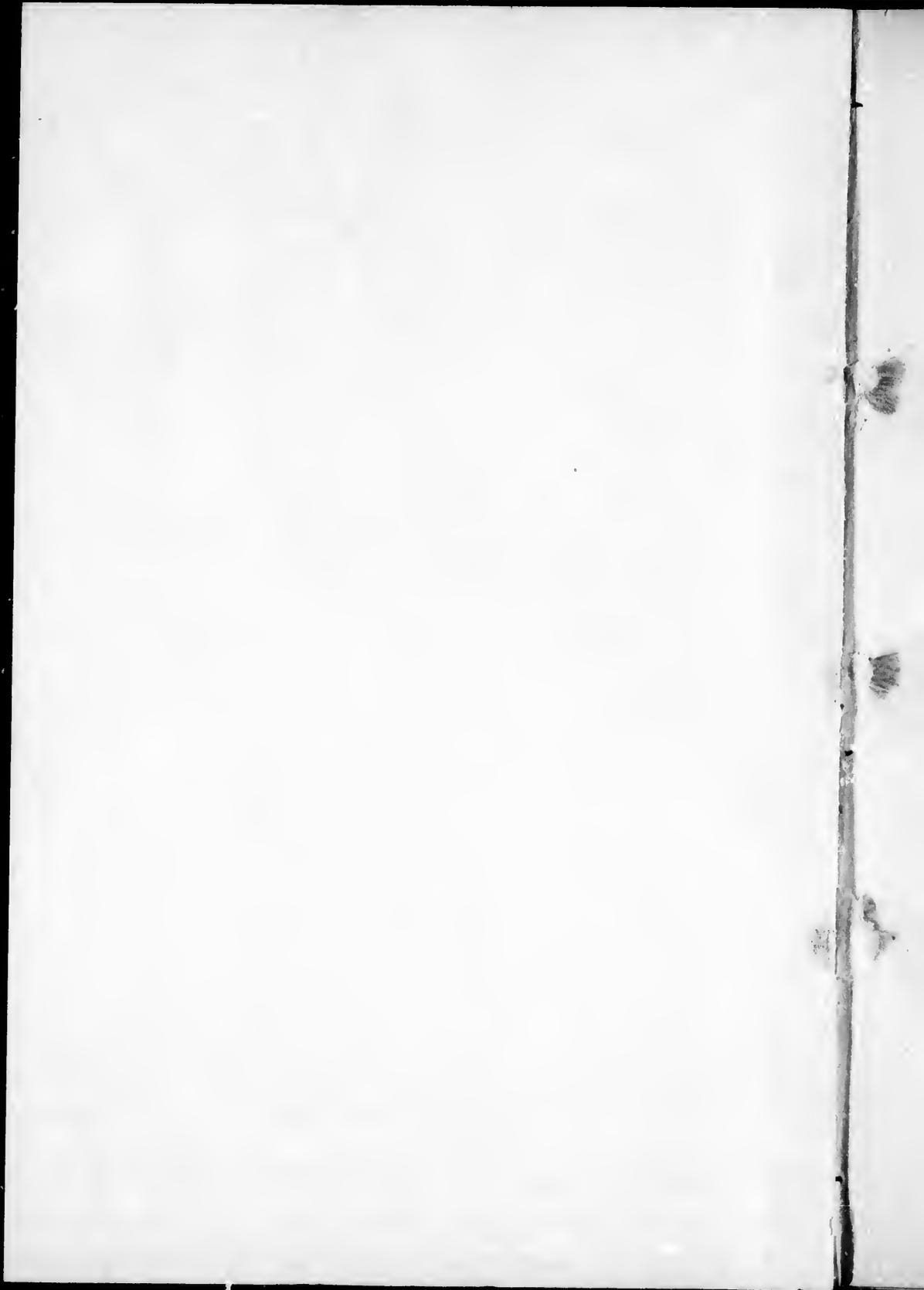
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SCIENCE AND RELIGION

AN ADDRESS

DELIVERED AT THE CONVOCATION OF MCGILL UNIVERSITY,
MAY 1ST, 1876.

TO THE

BACHELORS OF APPLIED SCIENCE.

BY

ALEXANDER JOHNSON, M.A., LL.D., DUBLIN.

*Professor of Mathematics and Natural Philosophy in the University ;
Vice-Dean of the Faculty of Arts.*



MONTREAL :

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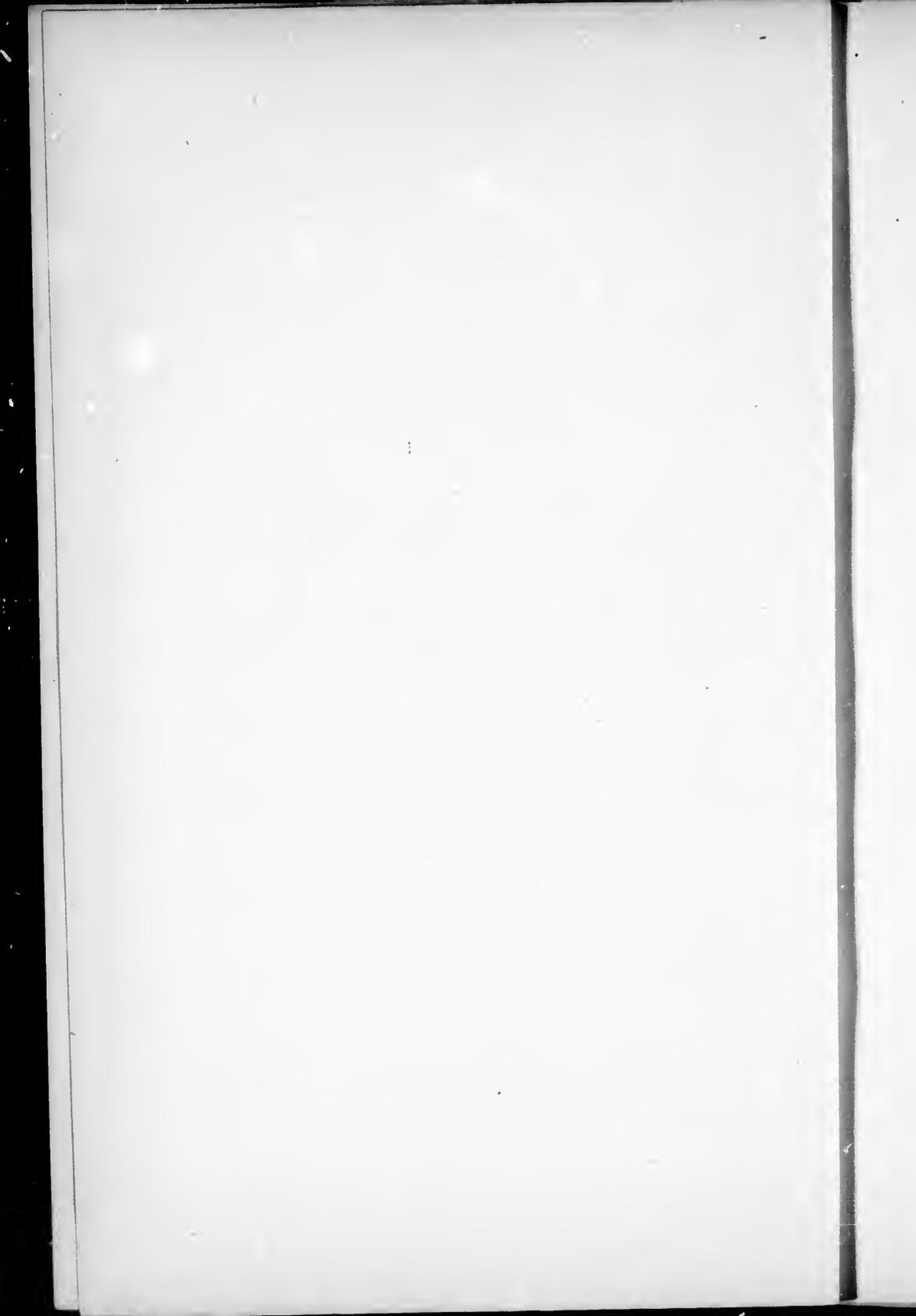
P R E F A C E .

The Address explains its own origin and object. Here it is only necessary to state why it is published in its present form.

It was first printed in one of the city journals, at the request and through the instrumentality of the Graduating Class. I subsequently received requests from different quarters to publish it as a pamphlet. From the reasons offered, and from conversations with several who have heard or read it, I have been led to believe that it may be more widely useful than I at first supposed.

It has been revised, and some notes have been added.

A. J.



ADDRESS.

GENTLEMEN, BACHELORS OF APPLIED SCIENCE :

It is usual, and it is fitting, that the Professor who, speaking on behalf of the Faculty, addresses those who stand in your position from time to time, should, in his parting words, not only convey our best wishes for your welfare (in that we must always feel interested), but also give, at the same time, such advice and warning as he may deem most suitable or most necessary. The advice may be too often forgotten, the warning may not be heeded ; the address itself, though listened to with respect, may be regarded as only one of the ceremonies of the day ; yet, on the other hand, they may sometimes be useful, and the impressive character of the occasion may stamp them on the mind with a force not to be obtained from ordinary circumstances.

It behoves me, therefore, to consider well how I shall best fulfil my duty in using the present opportunity. Which of the several subjects that offer themselves can be taken up with the greatest advantage to you ? On topics that are specially connected with the practice of your professions, I am not qualified to speak ; though, no doubt, you would be glad to get any suggestions that might have a relation to your success in life. Advice as to your future studies and future conduct, and warning as to future dangers in life, I might no doubt convey, and in other years I might probably have tried to fashion them as best I could in a general form. But this year one special subject has pressed

itself on my attention in a way that cannot be overlooked, and I have had no hesitation in selecting it as a fit theme for my remarks.

Success in your profession is greatly to be desired. Progress in your studies is necessary. But not of these shall I speak. Nor indeed shall I confine my address to you alone. On the contrary, I shall take advantage of the opportunity to turn myself to all those who, with you, have, during the last two years, been attending the lectures in Experimental Physics—and not even to those alone,—I wish that those other students who are in the earlier years, and who will attend the lectures that I may yet deliver in these subjects, should consider themselves as addressed.

My subject is one that has been agitating the minds of many during nearly two years past. A wave of disturbance originating in the address of the President of the British Association for the Advancement of Science in 1874 has rolled over the mother country, and crossing the Atlantic, diffused itself here far and wide. The disturbance then excited, the agitation of men's minds, and the discussions that followed, are still in full vigour, not only in Great Britain, but here in Canada;—possibly, they may as yet be only in their beginning in this country.

The discussions are carried on or noticed, not only in books, reviews and pamphlets, but in newspapers and in the social circle. When the newspapers teem with quotations from Tyndall, Huxley, Darwin and Herbert Spencer (no later than this morning I saw one from the last mentioned), and the mind of the nation in general is agitated, it is not to be supposed that the student's mind will escape that apprehension which lays hold of many when they are told that Science and Religion are irreconcilably at variance. When after

this, the student hears, as he must do, in his lectures, of "molecules," "atoms," "vibrations," and other terms which are bandied about so freely in these discussions, he may have some fears that he is entering on dangerous ground, and a feeling of uneasiness may seize hold of him, though he can see no precise cause for it. Such a result would be not unnatural, and I fancy that I have perceived traces of such uneasiness in questions that have been asked me during the session just closed.

I may be wrong, but there seems to be a vague notion abroad, among some at least, that there have been some recent grand discoveries in Science, which, only for the effects of prejudice, would overthrow the very basis of Religion; and in Physics, no less than in the other Sciences. Such a notion must operate prejudicially both to Science and to Religion. To do something to dispel it, if it exist, shall be my endeavour now. In my lectures I could not well have undertaken this, for the very sufficient reason, that there it is my duty to deal with Physical Science alone. To leave this and to go into the region of Metaphysics—for that is what must be done in order to follow those discussions—might neither be right nor beneficial on the whole. Nor, indeed, shall I do so now beyond one step. I shall confine my attention mainly, to showing that there are no good grounds for the impression that what are called the Atheistic or Materialistic conclusions, so loudly proclaimed by certain scientific men, and, among them, by Dr. Tyndall, have any support in Physical Science.

The most ready and simple method for effecting this, on an occasion like the present, is to quote the views of other scientific men, none of whom shall be less distinguished than Dr. Tyndall himself, and some of whom occupy, beyond question, a higher position. If I can produce the very smallest effect in helping to destroy

the notion that Science really supports the conclusions referred to, I shall have attained my object. It is the mixture of truth with error, of true scientific principles and illustrations, which so many can understand and follow with pleasure, with erroneous metaphysical reasonings slipped in incidentally, as it were, that causes all the evil.

It is my simple duty to do this. You must not be left to suppose from any silence on my part, either that I feel indifferent to a subject in which all must be deeply interested, or that I fear the strength of the arguments for infidelity, or that I favour them.

That all those whom I address may follow what I say, it is necessary to summarize briefly part of what you have learned in your course. I do so as follows:—

We learn from Chemistry that if we take any of the innumerable bodies which the world presents to us, whether it belongs to earth, or sea, or air, whether it be animal, vegetable, or mineral, it will be found when analysed to offer very little variety in its component parts; that they must belong to a list containing only sixty-three different elements, as far as known at the present time. We learn next from Physics that just as solid ice will melt into water, and water again if heated will take to itself wings and fly off as invisible vapour, so every solid body, even the very rocks themselves, may be reduced to a liquid state and, from the liquid, change to a gaseous or vaporous state. And, just as the process may be reversed, the invisible vapour of the air condensing into rain, that rain descending and gathering into streams and rivers, and those rivers being frozen, so we have reason to believe that every gas can be reduced by a proper amount of cold, through the liquid to the solid state. Applying these principles along with others, and examining our globe as a whole, we see reason to

believe that it was once a huge mass of fiery liquid rolling through space, surrounded by intensely heated vapours; in fact, like in all respects, probably, to the sun at present. Going farther back still, it is possible that it may have been in its earlier state a chaotic heap of vapour, part, perhaps, of an immensely larger mass. That the existence of vast gaseous masses out in space far beyond the boundaries of our little Solar system is possible, we know to a certainty, through the aid of the spectroscope. That the earth might have been once like these is quite possible. And what the earth once was that may all the planets have been. If we picture to ourselves this enormous mass of gas composed of few elements, and these elements themselves consisting of almost infinitely small particles, particles so small that they must be united in millions to be visible under the most powerful microscope, which particles are called molecules; (and not unfrequently atoms*) and then imagine these molecules in constant agitation, never at rest for a single instant, and moreover repelling or attracting one another, we have before us a general idea of what Physical Science presents as the not improbable state from which the present condition of the frame of the earth has been derived.

In this way the formation of the earth would have followed the order of the steps by which aerial vapour becomes solid ice. But modern discoveries point out that it would be also quite possible to have the process reversed for a solid body like the earth in its present state. For the Dynamical Theory of Heat shows us that if the earth came into collision with another sufficiently large body in space; nay, if without coming into collis-

* "An atom, if there is such a thing, must be a molecule of an elementary substance." "Every molecule is not an atom, but every atom is a molecule."—Prof. Clerk Maxwell, Lecture on Molecules.

ion at all, it were merely stopped suddenly in its course, it would be not merely wrapped in flames, but there would be sufficient heat to turn a great part of it into vapour. And there is good reason to suppose that collisions do take place in space. We have innumerable examples of them, on a small scale, in those meteoric stones which, coming out of the regions through which the earth speeds its course, and rushing through the atmosphere and striking against its surface, are melted or vaporized in part, if not wholly.

All this is taught by Physical Science as possible, and there is nothing whatever in it inconsistent with either Natural or Revealed religion. There can be no doubt that the views which it presents thus are wonderfully fascinating. Those vibrations of the molecules, their attractions and repulsions, which existed during the gaseous state, are still continued. It seems like a fairy tale to think, when we look around on the walls, the benches, and other solid objects in this hall, that the little particles which compose these apparently quiescent bodies are rushing to and fro, backwards and forwards, pulling or pushing one another. Or, to take a still more recent advance in scientific views, that the air about us when in its very quietest condition has all its particles in similar agitation; that they dash about us with a fierce velocity of about seventy miles a minute, (through very short distances, however, because they come into rude collision, one with another), and that what we call the pressure of the air on our bodies, is caused by their incessant beating upon us, pelting us as with a hail-storm; that, in short, when we look at a barometer, and see the mercury rise or the index turn, we see only the results of variations in the pelting of this storm. Or, again, think of these incessantly changing bodies which we call ours, but which are not ourselves, bodies which are not exactly the same now as

when we entered this hall, which will be different again when we leave it, which alter with every breath we draw ; bodies which we change in their entirety several times during our life. Does it not strike us with wonder and with awe to reflect that the very elements of them, which are for a moment at our command, should have been tossed to and fro, ages of ages ago, in that nebulous mist far-reaching into space, which is now condensed into the firm earth on which we stand ?

This, I repeat, is all taught us by Physical Science, but you know that we have not absolute demonstration for it, nor even for any part of it. Not even for the theory of gravitation, which is the most firmly established of all theories, have we what is equivalent to a mathematical demonstration. We have only *probability*; probability, it is true, of a very high order in some cases, sufficient to give us a firm conviction of the truth of the doctrines ; but probability of a very much lower order, indeed, in others.

For our purpose to-day, however, let us assume the theories or hypotheses to be absolutely demonstrated, and let us consider the deductions from them that have caused, and not unreasonably caused, such commotion within the last couple of years. Deductions, however, is hardly the right word ; they are little more than *opinions* or *beliefs*, for that is really all the weight that is claimed for them. And just here lies one of the gravest and most common mistakes. It is in supposing that Dr. Tyndall asserts that he has *proof* for these opinions or beliefs of his, if anything so negative as some of the views he holds can be called a belief. Another great and common error is in supposing that Dr. Tyndall's opinions are more antagonistic to the basis of religion than they really are. Atheists will find very cold comfort indeed

in his utterances. He asks himself the question in one place* when taking a survey of the universe—"Can it be possible that man's knowledge is the greatest knowledge—that man's life is the highest life?" and answers in the negative. He speaks, moreover, in his celebrated Address, of the manifestation in nature "of a Power absolutely inscrutable to the intellect of man."† In his latest paper,‡ referring to the power which he claims for matter, he says: "How it came to have this power is a question on which I have never ventured an opinion."—"Theories of Evolution go but a short way to explain this mystery."—He admits besides, nay, he asserts in the strongest terms, the essential distinction between Mind and Matter, the impassable gulf which prevents us from seeing the connection between them.

But having said thus much, in doing him the justice which he claims, and fairly claims, as his right; and having accepted all that he will concede to us, and they are very important concessions, it must be stated that, notwithstanding all this, his opinions or beliefs (remember they are no more than this) are thoroughly subversive of true religion, and must be opposed with all the vigour and all the vigilance of which our minds are capable.

Be careful, too, never to forget that in maintaining these views of his, he has left behind him all that influence which he possesses in the region of Physical Science. He is like a potentate who has come into a foreign country, whose inhabitants may, indeed, receive him with courtesy, but will altogether deny any claim of his to authority.

* Lecture on Crystals and Molecular Force.

† "The Power which the Universe manifests to us is utterly inscrutable."

—H. Spencer, *First Principles*, p. 46.

‡ *Fortnightly Review*.

It is of the utmost importance to keep this caution constantly before the mind. It is to the neglect of it, or to the want of knowledge of the border line between the two regions in which he travels that a great part of the general anxiety and commotion has been due. I will quote his own words here on this point: "When the human mind has achieved greatness, and given evidence of extraordinary power in any domain, there is a tendency to credit it with similar power in all other domains." Let us accept the caution implied here. He cannot, on any strong grounds of evidence, object, if men should apply to himself, the statement that he, mistakenly—if we believe Sir David Brewster*—makes concerning Newton, and should say, "that the very devotion of his powers, through all the best years of his life to a totally different class of ideas, not to speak of any natural disqualification, tend to render him less instead of more competent to deal with theological and historic questions."

With this to guide us, we see at once whence, possibly arises the difficulty which he expresses in his latest utterance: "When I attempt to give the Power which I see manifested in the universe an objective form, personal or otherwise, it slips away from me, *declining all intellectual manipulation.*" "Its mystery overshadows me, but it remains a mystery." He cannot grasp all that is involved in the thought of a Personal and Intelligent Creator and Ruler of the Universe; he cannot comprehend it—for the simple reason that he demands more than is given to man to comprehend. He sets a high value upon what is expressed by the German term, "*Vorstellungsfähigkeit*," which he defines to be "the power of definite mental presentation." He has been during all his scientific life accustomed to deal

* See Memoirs of Sir Isaac Newton, Vol ii, p. 313-315.

with definite pictures of material bodies, of material atoms, floating and dancing before the mental eye. Hence when he comes to deal with the immaterial, he finds it, as he himself says with regard to mind, "an impenetrable mystery." It cannot be pictured as he pictures atoms. If we followed his example, we should do as Locke says, speaking of men of not unlike principles a couple of centuries ago: "We should sit still, and not set our thoughts at work at all, in despair of knowing anything, because some things are not to be understood." Newton, who lived at the same time as Locke, found it as impossible as Dr. Tyndall finds it, to comprehend the Omniscient; yet he did not, on that account, turn his mind away from God. "As a blind man," he says, "has no idea of colours, so we have no idea of the modes in which God, Most Wise, perceives and understands all things."†

Now, this is neither the time nor the place to take up the examination in detail of the opinions of Dr. Tyndall, or of those of the same school. I shall simply remind, or point out to, you that there is a principle in our nature, a principle irresistible in its authority, a principle which is equally strong in the peasant and in the philosopher, which compels us to rise from the contemplation of mere movements of matter to the contemplation of a Personal and Intelligent Creator. When you see a movement you cannot help asking what is the

† "Ut caecus non habet ideam colorum, sic nos ideam non habemus modorum, quibus Deus sapientissimus sentit et intelligit omnia.—Ideas habemus attributorum ejus, sed quid sit rei alienius substantia minime cognoscimus. Videmus tantum corporum figuras et colores, audimus tantum sonos, tangimus tantum superficies externas, olfacimus odores solos, et gustamus sapes: intimas substantias nullo sensu, nulla actione reflexa cognoscimus; et multo minus ideam habemus substantiae Dei. Hunc cognoscimus solummodo per proprietates et attributa et per sapientissimas et optimas rerum structuras et causas finales."—Newton, Principia, Scholium generale.

cause of it. You say, and you necessarily reply, it is *force*—but the instant you say that, you have passed from the boundaries of mere matter. We derive our very idea of force as acting on matter from the power of our own mind over our body.* We know that it is our *will* that sets our various members in motion—*how*—we know not. The connection we cannot explain. But that it exists we are certain. Hence when we see motion in the external world, and speak of force, we are necessarily led in thought at last to a Will operating, and thence to an Intellect, and “to all those attributes of mind in which—and not in the possession of arms, legs, brains, and viscera—personality consists.†” But we must not enter into metaphysical discussions here.

Let us at once seek the opinions of men of the highest eminence in science, and see whether they find

* This idea [of Cause]... is not derived from experience, but has its origin in the mind itself.—By cause, we mean some quality, power, or efficacy by which a state of things produces a succeeding state. Thus the motion of bodies from rest is produced by a cause which we call *Force*.—Whewell, *History of Scientific Ideas*, Vol i, p. 173.

Dr. Tyndall also seems to hold this opinion. In his *Lecture on Crystals and Molecular Force*, pp. 70, 71, he says: “In order to trace the genesis of the notions now entertained upon the subject (crystalization) we have to go a long way back. In the drawing of a bow, the darting of a javelin, the throwing of a stone, in the lifting of burdens, and in personal combats, even savage man became acquainted with the operation of *force*.” Then, “by a kind of poetic transfer, he applied to things external to himself the conceptions derived from the exercise of his own muscular power.” For example: when he had observed that rubbed amber attracted light bodies, and that a magnet could attract or repel, he came to the conclusion that “the magnet and the rubbed amber exerted force.” The origin being thus admitted, it appears of little moment what the “transfer” is called. Yet, Dr. Tyndall in speaking of the “Power” which he sees “manifested in the Universe,” “dare not call it a ‘Mind.’” But we should notice that he does not at all deny that it may be. Here, however, he has left his own domain and got into metaphysical regions.

† Sir John Herschel.

anything inconsistent with the knowledge of a personal and intelligent Creator and Ruler of the universe in the scientific idea of molecules or atoms to which I have alluded. We shall find the very contrary.

Sir John Herschel says, "we have the strongest evidence that these 'atoms' may all be arranged in a very limited number of groups or classes, all the individuals of each of which are, to all intents and purposes, *exactly alike* in all their properties. Now, when we see a great number of things precisely alike, we do not believe this similarity to have originated except from a common principle independent of them; and that we recognize this likeness, chiefly by the identity of their deportment under similar circumstances, strengthens rather than weakens the conclusion. A line of spinning-jennies [in a cotton mill], or a regiment of soldiers, dressed exactly alike, and going through precisely the same evolutions, gives us no idea of independent existence; we must see them act out of concert before we can believe them to have independent wills and properties, not impressed on them from without. And this conclusion, which would be strong even were there only two individuals precisely alike in all respects and for ever, acquires irresistible force when their number is multiplied beyond the power of imagination to conceive. If we mistake not, then, the discoveries alluded to effectually destroy the idea of an *eternal self-existent matter*; by giving to each of its atoms the essential characters at once of a *manufactured article* and a *subordinate agent*."*

This was written about forty years ago, and the same idea and the same striking expression, "manufactured articles," were repeated again in another work by

* Preliminary Discourse on the Study of Natural Philosophy. Chap. 3.

him a few years ago.* To appreciate the full force of his argument and illustrations of spinning-jennies and soldiers, you have only to think of those beautiful effects of crystallization which you have seen, and to which Dr. Tyndall so often alludes.

Listen now to what is said by one of the great living authorities on the subject of molecules—one of those who have specially distinguished themselves by investigation concerning them—Prof. Clerk Maxwell, of Cambridge. One passage that I shall give has often been quoted already, but it will bear, and it deserves, frequent repetition. The extracts are from a lecture† of his, wherein he describes the methods of the various investigations. He gives some of his conclusions as follows: “In the heavens we discover by their light, and by their light alone, stars so distant from each other, that no material thing can ever have passed from one to another; and yet this light, which is to us the sole evidence of the existence of these worlds, tells us also [by means of the spectroscope] that each of them is built up of molecules of the same kinds as those which we find on earth.” “Each molecule throughout the universe bears impressed on it the stamp of a metric system as distinctly as does the metre of the Archives of Paris, or the double royal cubit of the Temple of Karnac.” “No theory of Evolution can be formed to account for the similarity of molecules.” “None of the processes of nature, since the time when nature began, has produced the slightest difference in the properties of any molecule.” “On the other hand, the exact equality of each molecule to all others of the same kind gives it, as Sir John Herschel has well said, the essential character of a *manufactured article*, and precludes the

* Familiar Lectures on Scientific Subjects.

† Read before the British Association at Bradford, September, 1873.

idea of its being eternal and self-existent." "Though in the course of ages catastrophes have occurred, and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the molecules out of which these systems are built—the foundation stones of the material universe—remain unbroken and unworn. They continue this day as they were created, perfect in number and measure and weight; and from the ineffaceable characters impressed on them, we may learn that those aspirations after accuracy in measurement, truth in statement, and justice in action, which we reckon our noblest attributes as men, are ours, because they are essential constituents of the image of Him who, in the beginning, created not only the heaven and the earth, but the materials of which heaven and earth consist."

What has been said hitherto seems to have its bearing chiefly on inorganic nature. I have no time, nor does it lie specially within my province to speak of the application of the theory of Evolution to animal and plant. Naturalists will, in time, separate what is true from what is false here. But even were the whole theory true, it would not prove what some think it involves—the absence of "design" in the universe.*

* Dr. Haughton, Professor of Geology in the University of Dublin, a scientific man of the most varied attainments, an original worker, not only in the subject belonging to his Chair, but in Mathematics, Physics, Anatomy, and Physiology, published in 1873 the "Principles of Animal Mechanism," a work in which the higher Mathematics are applied to Anatomy. From it the following extracts are taken:—

Speaking of the possible evolution of the present state of the solar system from a past, he says:—"It was all foreseen, and the Evolution itself presided over by the Divine Mind that planned the whole. He then proceeds—

"I cannot see why there may not be in organic life a similar process of Evolution of higher from lower forms of existence, but it is a Teleological Evolution in which every step and every result was foreseen and planned beforehand. The laws of such an Evolution appear to me in the

The facts, whether taken separately or taken as a whole, on any theory, strongly contradict such an idea.* Dr. Tyndall, in his Address, gives us an imaginary development of the eye, "from a kind of tactual sense diffused over the entire body," from which any deduction of this character is overthrown at once by a simple question propounded long ago by Newton, viz. : "Did blind chance know that there was light, and what was its refraction, and fit the eyes of all creatures after the most curious manner to make use of it?" Newton was the man of the highest scientific genius who ever lived. This is acknowledged by all. But he was more than this. Sir David Brewster, an eminent scientific man himself, who, in writing his memoirs, had access to all his letters and necessarily knew his life intimately, states that had he not been so famous as a mathematician and natural philosopher, he would have been

present state of our knowledge, to be entirely unknown."—"I have explained the similarity of muscles and bones in the vertebrate animals on simple Teleological principles, without making use of the unproved hypothesis of their descent from a supposed common ancestor."—Preface.

"The skilful artisan can produce from the same number of wheels and pinions either a clock or a roasting-jack, fulfilling the very different functions of marking time and of roasting meat. An ignorant but intelligent savage, who was shown the interior of these machines, would come to the conclusion that they were very like each other, simply because he would only consider their superficial resemblances, and would be unable to appreciate the purposes which the machines were respectively intended to fulfil. In like manner anatomists from observations of apparent resemblances in the structure of organs, such as the brain, (of the specific action of whose parts little or nothing is known), have sometimes rashly inferred a greater degree of affinity between various animals than there is any logical ground for admitting. If we confine our attention to the arrangement of muscles and bones, the objects and uses of which are perfectly known and understood, we may readily perceive that under a superficial appearance of similarity of parts there really exists a profound difference of function and intention as to the purposes to which these organs are devoted."

* Take the following example from Huxley's "Lay Sermons," p. 261 : "Examine the recently laid egg of some common animal, such as a salamander or a newt. It is a minute spheroid, in which the best micros-

eminent as a theologian. In the above words we have his opinion on "design."

But it may be supposed that if he had any conception of the "grand generalizations" of modern science, his views would have been different. Curiously enough, as if to meet this supposition, we have on record in his life an "hypothesis" of his which seems to shadow out, in part, as if by anticipation, one of these generalizations, and even contains a term akin to one now well known. But it introduces the direct action of the Creator to a degree that Evolutionists would hardly approve of. In it "he supposes an ethereal medium rarer than air, subtler, and more elastic; not one uniform matter, but compounded of various ethereal spirits or vapours, with

cope will reveal nothing but a structureless sac, enclosing a glairy fluid, holding granules in suspension. But strange possibilities lie dormant in that semi-fluid globule. Let a moderate supply of warmth reach its watery cradle, and the plastic matter undergoes changes so rapid and yet so steady and purposelike in their succession, that we can only compare them to those operated by a skilled modeller upon a formless lump of clay. As with an invisible trowel, the mass is divided and sub-divided into smaller and smaller portions, until it is reduced to an aggregation of granules not too large to build withal the finest fabrics of the nascent organism. And, then, it is as if a delicate finger traced out the line to be occupied by the spinal column, and moulded the contour of the body; pinching up the head at one end, the tail at the other, and fashioning flank and limb into due salamandrine proportions, in so artistic a way, that after watching the progress hour by hour, one is almost involuntarily possessed by the notion, that some more subtle aid to vision than an achromatic would show the hidden artist, with his plan before him, striving with skilful manipulation to perfect his work."

So far we may follow with confidence the skilled observer and able naturalist, even though we may suspect, from his known opinions, that the description is a little emphasized for the sake of subsequent contrast. But when, on the following page, he says, "matter and force are the two names of the one artist who fashions the living as well as the lifeless," it must not be forgotten that he has here passed the boundaries of the science in which he has gained his high reputation; and that, accepting his evidence, those who are not naturalists may be in as good a position as himself for forming a judgment thereon in the new region.

the phlegmatical body of ether. The whole frame of nature may be nothing but various contextures condensed by precipitation, and, after condensation, brought into various forms, at first by the immediate hand of the Creator, and ever since by the power of nature; which by virtue of the command, 'increase and multiply,' became a complete imitator of the copies set her by the *protoplast*." "Thus," he adds, "perhaps may all things be originated from ether." Hypotheses, however, he thought very lightly of, and this one he devised only as an illustration of his "discourses" for the benefit of "some great virtuosos." Newton was not carried away by the transcendant greatness of his discoveries. On the contrary, they all led him up to the idea of the greatness of God, whose attributes he endeavors to express at the very end of his immortal *Principia*--the grandest scientific work that the mind of man has ever produced.*

But still it may be urged that science has made great advances since his time,—let us, therefore, get the opinion of him who occupies his place now. Professor Stokes, as described by Dr. Tyndall, is "the occupant of the chair of Newton in the University of Cambridge, one of those original workers, who, though not widely known beyond scientific circles, really constitute the core of science."† What does he say on this subject? Here are his words delivered as President of the British Association at Exeter:‡—"Let us fearlessly trace the

* "The number and generality of his discoveries—the multitude of original and profound views—will assure to the *Principia* a pre-eminence above all the other productions of the human intellect."—Laplace, *Exposition du Systeme du Monde*, liv. v., chap. v.; quoted in Grant's *History of Physical Astronomy*, chap. i.

† Lectures on Light, p. 128—American edition.

‡ In a short sketch of Prof. Stokes given in "Nature," July 15, 1875, Prof. Tait, (Professor of Natural Philosophy in Edinburgh), says of this

dependence of link on link, as far as it may be given us to trace it; but let us take heed that in the studying of second causes we forget not the First Cause, nor shut our eyes to the wonderful proofs of design, which, in the study of organized beings especially, meet us at every turn."*

But, gentlemen, I must not occupy your time too long. There is much more that I could say on this subject, but for which, as I have said already, this is neither the time nor place. What I have said, though not hastily thought of, has been very hastily put together, as must be too obvious. But the pressure of my college duties since first I learned that I was to speak here to-day, has not allowed me to do otherwise. My fear is that my brief—too brief for the subject—and hasty advocacy may be of little value. But less I could not say on such a topic, and I could not let you leave these halls without giving expression to my views. For myself, I am inclined to believe that, on the whole, Dr

Address:—"His modest but firm concluding paragraphs are well calculated to re-assure those who may have been perplexed by the *quasi-scientific* materialism of the present day.

It is no secret, since it has been stated in at least one of the Reviews, that Prof. Tait and Prof. Balfour Stewart (Professor of Natural Philosophy Owen's College, Manchester), are the joint authors of a work recently published—"The Unseen Universe"—although no names appear on the title-page. The following extracts are from the preface:—"Forgetful of the splendid example shown by intellectual giants like Newton and Faraday, and aghast at the materialistic statements now-a-days freely made, (often professedly in the name of science) the Orthodox in religion are in evil case." "Our object in the present work is to endeavour to show that the presumed incompatibility of Science and Religion does not exist. This indeed ought to be self-evident to all who believe that the Creator of the Universe is Himself the author of Revelation. But it is strangely impressive to note how very little often suffices to alarm even the firmest of human faith."

* This address has such an important relation to that of Prof. Tyndall, in the part which treats of the connection of Matter and Life, that a fuller extract is given in an appendix.

Tyndall has done good service to the cause of religion by so openly and boldly proclaiming the doctrines of its opponents. He has gained an attention for them which they would not have received in other hands. He has thus caused many, who might otherwise have been unconscious, or even careless, of the extent to which the faith of multitudes was being quietly sapped, to come forward in reply. He has aided in forcing on theologians the necessity for a study of Physical and Natural Science, if they are to be prepared to meet the enemy on his own ground. More than this, by compelling an examination into the grounds of their belief, on the part of others, who had been shrinking from the task in a cowardice that was itself the next thing to infidelity, he has probably strengthened their faith and confirmed their hopes. The effect that his energetic opinions have in this way produced may be described by a simile, employed on a different occasion by the celebrated Faraday, one of the group of the great scientific men who have but recently passed from us, one whom Dr. Tyndall looked up to in Tyndall's own department, and to whom he assigns rank as the Prince of experimentalists; but who refused to stir beyond the boundaries of his own science, and to run the risk of the intellectual quagmires that beset the paths in the domain of Metaphysics, and who remained a firm and humble Christian to the last. The simile with which I shall conclude this Address occurs in a description of a scene he beheld when visiting Switzerland, at the Falls of Giessen. He is watching "the shoot of the cataract down the series of precipices. It is shattered into foam at the base of each, and tossed by its own recoil as water-dust through the air. The sun is at his back, shining on the drifting spray; and he thus describes and muses on what he sees:—'The sun shone brightly, and the rainbows seen from various

points were very beautiful. One, at the bottom of a fine but furious fall, was very pleasant. There it remained motionless, whilst the gusts and clouds of spray swept furiously across its face, and were dashed against the rock. It looked like a spirit strong in faith and steadfast in the midst of the storm of passions sweeping across it, and though it might fade and revive, still it held on to the rock as in hope and giving hope; and the very drops, which in the whirlwind of their fury seemed as if they would carry all away, were made to revive it and give it greater beauty.'"* Gentlemen, farewell.

* Faraday as a Discoverer, by John Tyndall, p. 78.

APPENDIX.

(Extracts from the Address of Professor Stokes, as President of the British Association, at Exeter, 1869.)

“ In the various processes of crystallization, of precipitation, and so forth, which we witness in dead matter, I cannot see the faintest shadow of an approach to the formation of an organic structure, still less to the wonderful series of changes which are concerned in the growth and perpetuation of even the lowliest plant. Admitting to the full as highly probable, though not completely demonstrated, the applicability to human beings of the laws which have been ascertained with reference to dead matter, I feel constrained, at the same time, to admit the existence of a mysterious *something* lying beyond—a something *sui generis*, which I regard not as balancing and suspending the ordinary physical laws, but as working with them and through them, to the attainment of a designed end.

“ What this *something*, which we call life, may be, is a profound mystery. We know not how many links in the chain of secondary causation may yet remain behind ; we know not how few. It would be presumptuous, indeed, to assume, in any case, that we had already reached the last link, and to charge with irreverence a fellow-worker who attempted to push his investigations yet one step further back. On the other hand, if a thick darkness enshrouds all beyond, we have no right to assume it to be impossible that we have reached the last link of the chain ; a stage where further progress is unattainable, and we can only refer the highest law at which we stopped to the fiat of an Almighty Power. To assume the contrary as a matter of necessity, is, practically, to remove the First Cause of all to an infinite distance from us. The boundary, however, between what is clearly known and what is veiled in impenetrable darkness is not ordinarily thus sharply defined. Between the two there lies a misty region, in which loom the ill-discerned forms of links of the chain which are yet beyond us ; but the general

principle is not affected thereby. Let us fearlessly trace the dependence of link on link as far as it may be given us to trace it; but let us take heed that in thus studying second causes, we forget not the First Cause, nor shut our eyes to the wonderful proofs of design which, in the study of organized beings especially, meet us at every turn. * * * * *

“When from the phenomena of life we pass to those of mind, we enter a region still more profoundly mysterious. * * * * * Science can be expected to do but little to aid us here, since the instrument of research is itself the object of investigation. It can but enlighten us as to the depth of our ignorance, and lead us to look to a higher aid for that which most nearly concerns our well-being.”

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