INTRODUCTORY ADDRESS

ON

MAN'S PLACE IN CREATION;
HIS EDUCATION AND DEVELOPMENT
FROM A SCIENCE POINT OF VIEW.*Delivered at the University of St. Andrew's.*By JAMES BELL PETTIGREW, M.D., F.R.S.,
Professor of Medicine and Anatomy in the University.

THE spectacle presented by creation is a great and sublime one, and it rises in grandeur and sublimity in proportion to the intellectual grasp and acumen of the beholder, and according to the amount of law and design which it reveals to his astonished gaze.

The theories of the formation of the universe are numerous, but there are two leading theories, and to these I will refer very briefly. 1. There are those who attribute everything that exists to a spiritual agency, or, what is the same thing, a divine power. 2. There are those who persistently maintain that the universe and all it contains is due to an accidental assemblage of parts mutually acting and reacting upon each other. Newton and Swedenborg, *e.g.*, support the former view, and Haeckel and Tyndall the latter. These four philosophers equally assume the existence of matter for their systems of the universe, but there is this fundamental difference between them: Newton and Swedenborg attribute the disposal, arrangement, and movements of matter directly to divine interposition and agency; whereas Haeckel and Tyndall refer everything to a power inhering in the matter itself. In other words, Newton and Swedenborg admit that matter, once created and placed in certain conditions, will obey certain laws; they, however, deny that matter can accomplish anything of itself, which is the position defended by Haeckel and Tyndall.

These two theories, I need scarcely remark, are diametrically opposed to each other. In the one case, we have matter, even the particles of matter as well as the larger masses, controlled and directed by intelligence divine in its origin and operation; in the other, we have the same matter asserting itself and obeying certain inherent laws in the absence of a creator, *i.e.*, of a divine, intelligent first cause. It is impossible, even in these advanced days, to pronounce with any degree of certainty on the gigantic problem of creation. Our intelligence, as well as our experience, are too limited to be of much value in forming a correct estimate. By assuming a first cause, in other words, a power which is capable not only of creating, but also of controlling matter, we evade many of the difficulties, if we do not solve the mystery of creation. It is natural for us to believe that whatever exists was created. In other words, we are not accustomed to think anything makes or fashions itself. This is according to revelation, tradition, and human experience. *Ex nihilo nihil fit*: there is nothing from nothing. The sceptists, however, maintain that this reasoning is essentially false or vicious—that it begs the question to be proved. They in fact assert that, if a first cause be insisted upon as necessary to creation, then the first cause itself must have had an origin or been preceded by another cause, and so on, *ad infinitum* or indefinitely. According to the strict rules of logic, the sceptists are quite entitled to press the argument in this direction and to this issue; but in so doing they land themselves in a *reductio ad absurdum*, for, in denying a beginning or first cause to their adversaries, they are themselves compelled to evolve a world out of nothing, which is impossible. One of two things is quite evident; either there must have been a first cause or power capable of creating and directing matter; or matter—inert, senseless matter—must have formed itself out of nothing, which, to say the least of it, is exceedingly improbable. If we accept the sceptists' view, *viz.*, that matter is self-forming and self-regulating, we encounter many difficulties; for this conclusion is at variance, not only with revelation and tradition, but also with our everyday experience.

We have no proof that matter can form itself, and we feel we can control matter in spite of itself. The theistical is more natural than the atheistical view, inasmuch as we see in the design everywhere present in the universe the exercise of an intelligence akin to our own. While we can control matter, we cannot form it. The existence of matter is utterly inexplicable, unless we assume it to be the creation of a power superior to all matter. Given matter, however, we can readily understand how force acts upon it—the force inhering in it,

and being inseparable from it. Particle attracts particle, the larger mass attracts the smaller, gravitation tends to bring everything into its proper place. While science has not been able to clear up the gigantic mystery of creation, it has been able to prove two things in connection with it of great importance—*viz.*, that matter and force are both indestructible. We can alter the form of matter and direct its forces; but we cannot annihilate matter, neither can we destroy its potential or inherent energy. There is a store of matter and a store of force in the universe which are indestructible and inexhaustible. This is a great fact; as all plants and all animals, even man himself, are formed from the matter of the universe, and are impelled, within certain limits, by the forces of the universe. If matter and force are taken from the universe to build up a plant or an animal, they both return to it when the plant or animal dies. The universe is not only the great laboratory where everything living is fashioned: it is also the vast lumber-room where everything dead is stored. It is the huge magazine of extinct or geologic forms. The organic rises out of the inorganic, and returns to it. We cannot speak of even the lowest plant or animal, still less of man, without referring to the matter of the universe. In all the transformations of plants and animals, even up to man himself, we behold the action and reaction of matter upon matter and force upon force. Geology, stretching far back through the vista of ages, has come to the conclusion that at one period our earth was uninhabitable, even for plants. There is nothing improbable in this. We see the rocks moulder in the light; and the rocks themselves, originally bald and barren, in due time furnish a soil which supports a low form of vegetation—this, after a while, affording the conditions necessary for a higher form of vegetation. The coral reefs, in like manner, crumble to pieces from exposure, and ultimately support groves of palms and other tropical plants. A certain degree of preparation was therefore necessary before plants could exist on the earth. But the great race of animals could not exist without the great race of plants. Plants, consequently, had to be formed before animals could be formed; and the last animal to be formed was man. Geology and Scripture quite agree as to the order of creation. The points of difference and divergence chiefly relate to the time required. It is quite evident, from geological records, that the world and the inhabitants thereof were not created in six ordinary days. Theologians of late years have expanded each day into a thousand years, and have fixed six thousand years as the time required for creation; but even this time, vast as it may seem, is considered by many of the most profound thinkers as altogether inadequate. Indeed, not a few of the most advanced philosophers regard creation rather as a progressive than a finished work; and many weighty arguments can be adduced in support of this view. The geological or scientific account of the order of creation has been stated with great force by Sir Humphry Davy as follows. "In those strata which are deepest, and which must, consequently, be supposed to be the earliest deposited, forms even of vegetable life are rare; shells and vegetable remains are found in the next order; the bones of fishes and oviparous reptiles exist in the following class; the remains of birds, with those of the same genera mentioned before, in those of the next order; those of quadrupeds of extinct species in a still more recent class; and it is only in the loose and slightly consolidated strata of gravel and sand, and which are usually called diluvial formations, that the remains of animals such as now people the globe are found, with others belonging to extinct species. But, in none of those formations, whether called secondary, tertiary, or diluvial, have the remains of man, or any of his works, been discovered; and whoever dwells on this subject must be convinced that the present order of things, and the comparatively recent existence of man as the master of the globe, is as certain as the destruction of a former and a different order, and the extinction of a number of living forms which have no type in being." Sir Charles Lyell writes in a very similar strain. He observes: "We have been fairly led by palaeontological researches to the conclusion that the invertebrate animals flourished before the vertebrate; and that in the latter class fishes, reptiles, birds, and mammalia made their appearance in chronological order analogous to that in which they would be arranged zoologically, according to an advancing scale of perfection in their organisation...To crown the whole, the series ends with the archencephala, of which man is the sole representative."

It is customary to speak of man as the lord of the creation; nor can this lofty title be well denied him, since revelation and science equally support it. He is mentally and physically fitted for command. While claiming for man the first place in creation, I am not of those who seek to elevate man by depressing the lower animals; all are perfect after a fashion. To argue otherwise would be to attribute imperfection to the Deity. Man has very many points in common with the brutes, not only physically, but mentally; and, so far from denying those points

of analogy, affinity, and, it may be, of actual consanguinity, I am proud to think that God, in his great goodness, has surrounded us with so many beautiful creatures, not a few of them having even beautiful dispositions. Granting, however, that man is, as to his animality, not far removed from the highest of the lower animals, and that he possesses certain mental traits in common with them, he is still *facile princeps*, and there is a great gulf between him and his congeners, which science has hitherto failed to bridge. The gulf is chiefly an intellectual gulf, for it cannot be doubted that there is a greater chasm between man and the higher apes, as regards intelligence, than there is between the several kinds of apes and the organic forms immediately below them.

If, as I have endeavoured to show, man's true greatness is traceable not to his physical structure, where he touches the lower animals at many points, but to his intellectual attributes, where he leaves them untold leagues behind, it follows that the chief business of science and university and other training, is to teach or educate man. The burning question of the day is education. We have our board and other schools, high and low; we have our colleges, technical and otherwise; we have our universities; and, within the last few years, even our Professor of Education. Education, from the earliest times, has been a subject of solicitude. Our views regarding it are, and ever have been, fluctuating. The ancients were not agreed upon it, neither are the moderns. The term education, as you are all aware, is from the Latin *educō*, to lead, or draw out, and represents the ancient idea of what intellectual training should be. The ancients believed, and I think rightly, that men varied as to intellectual capacity and endowment, and that it was the province of education to draw out of the man that which naturally inhered in him. The more modern (and I believe the less philosophic) view takes for granted that men vary little to begin with, and that everything may be put into them by a process of cramming. The ancients aimed at teaching men to think and judge; the moderns have no soul above passing examinations, and getting on in the world. As a physiologist, my sympathies are wholly with the ancients. I feel and believe that men vary infinitely, even from childhood. One has only to watch the progress of the innocent and helpless babe, as he progresses in consciousness and strength, to be convinced of this. The little cherub reveals, amid all his smiles, a certain something which is vaguely designated temper, but which in reality is disposition, or intellectual idiosyncrasy, or endowment. This deepens as he grows older, and it is in this sense that Wordsworth regards the child as "father of the man". The germ of certain things (mental as well as physical) exists in the child from the beginning, and urges him, *volens volens*, to do certain things, and to leave other things undone, or to do them in a very perfunctory or careless manner. The intellectual differences in the child altogether outweigh the physical differences; and hence it follows—and this is a matter of daily experience—that, of two children similarly placed as regards opportunities for learning, the one becomes ultimately a scholar, and it may be a philosopher, while the other barely attains a position of mediocrity. This shows that, while education can do a great deal for an individual, it cannot do everything. It explains how the immortals, Shakespeare and Burns, and a galaxy of great and distinguished men, towered like pyramids above their fellows with very little education, and, as it were, in spite of it. The vigour of some minds is such, that they are superior to education; and their greatness wells out of them like springs of living water, irrigating and beautifying the barrenness of mankind as a whole. These are the geniuses of our race. They spurn all mental direction and restraint, and soar above the common herd as the huge lammergeyers soar in mid heaven above the loftiest Alpine peaks. Some there are who deny the existence of genius, and accredit mere plodding with everything that is lofty in design and execution. Such men are plodders themselves, and incapable of appreciating the situation. It requires genius to appreciate genius, in the same way that it requires diamond to cut diamond. The unanswerable reply to all such is, that the genius cuts out new paths for himself; he even creates the tools with which he works; he, in fact, indirectly supplies the materials and appliances which enable the plodders to proceed. The geniuses, unfortunately, are few in number, as compared with the great mass of mankind; and it is for the latter that education is called upon more strictly to provide. That geniuses exist, and that they are, with few exceptions, the great leaders of the people, is as certain as that the sun shines above our heads. This holds true from Moses downwards. The movements of genius are often very erratic; but the grace and splendour of those movements delight and dazzle mankind. It is intellect which rules, and one of the great problems of the day (as it has been of all time) is how to develop and cultivate that intellect. How can we, in short, make the most of intellectual man? Is he to be educated by mere symbols, and taught by rote like a parrot, exer-

cising his tongue to the detriment of his head and heart? or is he to be confronted with Nature in her vastness and her grandeur, and to be taught that he forms part of the mighty universe, and that his chief business on earth is to understand himself and the universe of which he is a part; and, more important than all, to realise in the universe and in himself the omnipresent Creator of both?

The two great modern schools of education are widely divergent: the one seeks by symbol and cypher to impart to the young and inexperienced head abstract ideas and truths about men and things: the other aims at instructing youth, not by symbols and the mere names of things, but by the things themselves; these, fortunately for science, being strewn around us in prodigal profusion. The former method (the symbol teaching) leans principally upon memory, and is eminently unattractive to the young mind. It has, as a consequence, proved a comparative failure. The latter method (the object lesson method) is quite a seduction for children. It leans less—indeed, comparatively little—on memory, and provokes thought and reflection. The object lesson method expands the reason, and develops and corrects the judgment. As an illustration of what I mean, take the following. The symbol teacher, if he wish to convey an idea of a butterfly to his young audience, describes, or, at most, shows a picture of it; the object teacher, on the contrary, shows the butterfly in all its gorgeousness of colour, and very probably causes it to fly in their delighted presence. It is not difficult to understand which system of teaching is most agreeable to the young mind, and which system makes the most profound impression on the highly sensitive and susceptible brain of youth. There is a mighty difference between the abstract and the concrete as vehicles of education, and between the symbol and the thing the symbol represents; and the question naturally arises, Why deal so largely with symbols, when we can, in the majority of cases, deal with realities? Why cram the young head, all too small, with roundabout descriptions of things, when the things themselves may more conveniently be stowed away? I cannot conceive anything more painful than a child endeavouring to understand and remember a thing which he has never seen, and of which even his teacher (from the faulty system of education at present in vogue) has a very hazy conception.

So much for the school, and now for the university. Matters are, I regret to say, little better here. The vicious system of teaching which degrades the schools, also degrades, within certain limits and with certain exceptions, the universities, and especially our much cherished and boasted Scottish universities. I allude now more particularly to the training given for the Master of Arts degrees in the Scottish universities—the teaching in medicine and surgery and a few other departments having of late years improved to a very remarkable extent. For two centuries at least, the Scottish universities, as far as the Master of Arts degree is concerned, have made little advance in their methods of instruction. During that period, however, science has made enormous strides, and the country is clamant for the admission of a more liberal importation of science into that degree. In the University of St. Andrew's, that grand old institution of which all true and patriotic Scotsmen are so justly proud, there are five science chairs, viz.: Mathematics, Natural Philosophy, Chemistry, Physiology, and Natural History; but the first two only are permitted to take part in educating for the Master of Arts degree; the three latter, viz.: Chemistry, Physiology, and Natural History, being left out in the cold. The University of St. Andrew's, considering the number of its professors, is strong in science; but, owing to existing regulations, three of the science professors, as stated, are kept, much against their will, at an outside.

In their case, the rich stores of knowledge are spread out as a dainty repast, of which the students can only partake very sparingly. There are many reasons for this. 1. Attendance on chemistry, physiology, and natural history is not required for the Master of Arts degree (this is true of all the Scottish universities). 2. The classes for the Master of Arts degree are numerous and repeated, and so arranged that it necessitates a very considerable effort, and not a little sacrifice, on the part of the student to attend chemistry, physiology, and natural history, a still greater effort being required to graduate in science. 3. Lastly, the chairs of Chemistry, Physiology, and Natural History (and I say this with extreme regret) have no bursaries or scholarships attached to them. Science, in the case of the three chairs in question, is to be cultivated and wooed for herself alone. There is, however, this consolation, that science, like virtue, is its own reward. The difficulties with which the chairs of Chemistry, Physiology, and Natural History have to contend, I regard as a misfortune to the University of St. Andrew's, and an especial misfortune to its students, for I cannot help feeling that an university is strong and useful in proportion to the amount of science taught in it. Science (natural and otherwise) forms, it appears to me,

the very pinnacle of all learning and all culture; and no student, I take it, can be regarded as either learned or cultured, in the highest and best sense, who is ignorant of science. In saying so much, I think I have the feeling of the country with me.

The Scottish Universities' Commissioners, so recently as 1878, have fully recognised the importance of science in the Scottish universities; and one of their recommendations is to the effect that the Master of Arts degree shall be opened up to admit more of science. According to the recommendation in question, the Master of Arts degree of the immediate future will be approached by any one of five avenues: (1) Literature and Philology; (2) Philosophy; (3) Law and History; (4) Mathematical Science; and (5) Natural Science. If this recommendation be carried out by the forthcoming Universities' Executive Commission a year or so hence, it will then be possible to obtain a Master of Arts' degree on science lines, as in the physical tripos of Cambridge. Another important recommendation, and one which will probably be adopted by the Executive Commission at the same time, is the institution of a first or entrance examination: this entrance examination to be passed before the student enters on the curriculum for the degree of Master of Arts. The entrance examination will be the test for general culture, and when it is passed the student will be permitted to select any one of the five avenues or lines which lead up to the Master of Arts' degree. It will then be the privilege of the student to choose his own intellectual pabulum, inasmuch as he may select any one of the five routes indicated for the degree in question. A certain amount of differentiation in the subjects for the Master of Arts degree has become a necessity. Every one feels that he can do some things better than others, and that it is a matter of the last consequence to his happiness and prospects in life to be permitted to pursue his studies on congenial lines. Some love languages, some mathematics, some physics, some chemistry, some physiology, some natural history, and so on; but as every one is not an Admirable Crichton, it will be for him to choose, when the new *régime* is established, those subjects and those professors calculated to give him the greatest pleasure and the greatest amount of profitable instruction. Then, and not till then, will learning and culture in the highest sense abound in the country: then, and not till then, will there be variety in learning and culture; then, and not till then, will the so-called learned professions produce men of originality and power. It is hopeless with our present university regulations and crippled university machinery, to secure the greatest good to the greatest number, or the highest intellectual attainment to any. At present, the Faculty of Arts, in all the Scottish universities, educates principally for the Church and for the profession of teaching; but, as I have endeavoured to show, the training of the Arts Faculty errs from defect, because of its inadequate supply of science. The pulpit cannot in any sense be regarded as scientific, with a slight smattering of mathematics and natural philosophy; and the teacher, with simply a Master of Arts degree in his pocket, is in no sense efficiently equipped for educating the rising generation. The clergyman occasionally requires to cope with science, to do battle with it, and should know it; and the teacher of the present day is ever and anon called upon, even in primary schools, to descant upon Nature and Nature's works. As science can only be properly taught in the laboratory, it is sincerely to be hoped that the promised forthcoming Executive Commission will deal liberally with the Scottish universities, in everything that pertains to laboratories and practical science-teaching. These are, there is reason to believe, the very thews and sinews of education in the widest and best sense, and progress and civilisation are both retarded by their absence. Book-lore may be got anywhere, but practical science-teaching can only be had at fully equipped colleges and universities. The laboratories of the Continent, especially those of Germany (a comparatively poor country), are stupendous institutions. There the student has everything provided for him by the State. In Britain, the richest country in the world, the laboratories are few in number, and poorly equipped—the State, unfortunately, doing next to nothing for them. I need scarcely remark, that I anticipate the very best results from the opening up of the Master of Arts degree. It is quite evident that, if our youth are to have an opportunity of making themselves acquainted with all available knowledge, the greatest possible latitude must be allowed in the number of subjects for the degree in question; and the Scottish universities, and the University of St. Andrew's in particular, must not only avail themselves of all their existing chairs, but they must aim at founding new chairs, in order to afford scope and variety in learning. As I said, in my introductory lecture of last year, learning, if it means anything, means universality; and an university, to be strong, must abound in professors as well as students. Given the professors, their mode of teaching is still a matter of the utmost importance. Is the present generation to be satisfied with second-hand information, tradition, and books? or, is it to go, whenever practicable, to the fountain-head, and interro-

gate Nature directly? Tradition and book-teaching lead to prolixity, weariness, and error; laboratory and practical science-teaching lead to original research, progress, and truth. To my mind, mere book-lore is comparatively worthless, when compared with actual knowledge acquired from Nature. The most advanced educationists are disposed, and very properly, to make their teaching more and more practical; and hence the sudden outgrowth of late years of technical schools and colleges. The laboratory is at length beginning to supplant the closet. In science, the laboratory is a necessity. The science chairs of the University of St. Andrew's are eminently practical. This is especially true of the chairs of chemistry, physiology, and natural history. The last-mentioned chair is about to take a new departure, as regards the practical teaching of natural history. Our newly appointed Professor, Dr. W. McIntosh, LL.D., comes among us at great sacrifice, but with much enthusiasm and a splendid reputation; and the aim and ambition of his life is, I understand, to found a zoological station and great practical school of zoology at St. Andrew's. His opportunities for this will be of the very best, as our magnificent St. Andrew's Bay is second to none in Europe for the richness and variety of its botanical and zoological treasures. I sincerely hope that Dr. McIntosh's practical teaching will be duly appreciated, and that the St. Andrew's students will give him an enthusiastic reception, when he appears in our midst a few days hence. The object of the present lecture, as its title indicates, has been to show, so far as that was practicable within a limited time, the nature and order of creation—man's place in creation—man's intellectual supremacy; and the necessity for extending that supremacy by education, based, to a large extent, on Nature and Nature-teaching.

The importance of practical science training can scarcely be over-estimated. In all the walks of life, professional and otherwise, it has a high value. The pulpit is never grander, or more convincing, than when it ransacks heaven and earth for illustrations of unity and design; the bar pleads, nor pleads in vain, when it reveals an intimate acquaintance with nature, and especially human nature; and medicine is never so efficient or so profound, as when it studies, and extracts from the botanical and mineral kingdoms, those subtle essences which act like magic on the languishing human frame. As I have already stated, and I wish to repeat and emphasise that statement, I cannot regard anyone as thoroughly educated, who is ignorant of his surroundings and of himself. The educated man, whatever his proclivities, should know geography, astronomy, natural philosophy, mathematics, chemistry, anatomy, physiology, and natural history. "The study of mankind is man;" but man, as I have endeavoured to show, is an integral part of the great universe. He is more. He is a *Cosmos* in himself. To know man, we must anatomise him; we must know his mental and physical configuration; we must be acquainted with his various systems—his nervous system—his vascular system—his muscular system, and so on. We must also analyse his intellectual and emotional nature; we must sound the depths of his philosophy; must tap the springs of his passions and emotions before we can comprehend Shakespeare's sublime panegyric on the greatest of all created beings:

"What a piece of work is a man! How noble in reason; how infinite in faculties! In form and moving, how express and admirable! In action, how like an angel! In apprehension, how like a god! The beauty of the world! The paragon of animals!"

TO DISGUISE THE TASTE OF QUININE.—Mr. J. K. Lilly proposes the syrup of *erba santa* for the above purpose. Very little seems to be known about this substance. The purest state in which the writer has as yet been able to obtain it is in the form of an amber, mucilaginous mass, soluble in water and alcohol, insoluble in ether, benzene, and chloroform, precipitated by strong acids, and redissolved by alkalis. It may be prepared by mixing a fluid extract, made with a menstruum of not less than 75.9° alcohol, with an excess of water, boiling to drive off alcohol, shaking with finely powdered pumice, allowed to stand, then filtering, and the filtrate evaporated to the consistency of an extract. The following formula is proposed for the preparation of a syrup, which has proved to be very satisfactory: Fluid extract *erba santa*, four parts; water, eight parts; powdered pumice, one part; granulated sugar, fourteen parts. Mix the fluid extract with the water, evaporate to seven parts, shake with pumice, allow to stand, decant, add sufficient water to preserve measure, then with heat dissolve the sugar. The addition of fluid extract of liquorice in the proportion of half a drachm to the ounce of syrup, or of aromatics, adds somewhat to the elegance of the preparation. When quinine or other bitter substances are suspended in this syrup, their taste is completely masked. It is far superior to the liquorice preparations used for the same purpose, is pleasant and agreeable, and is easily prepared.—*Chicago Medical Review*, August 15th, 1882.