AN

HOUR IN A LIBRARY,

IN SEARCH OF NATURAL KNOWLEDGE.

Its relation to Literature, to Culture, and to Conduct.

A Lecture

DELIVERED BEFORE THE

SUNDAY LECTURE SOCIETY,

ST. GEORGE'S HALL, LANGHAM PLACE,

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SYLLABUS.

Popular division of Knowledge into Natural and Supernatural.

These distinctive terms current in England since the establishment of the Royal Society in 1662.

Historically the distinction is traceable in Europe beyond the fourth century before Christ.

Natural Knowledge is the result of human Observation, Experiment, and Reasoning, and is here regarded as embraced by the Physical, Mental, and Moral Sciences; hence Religions, Theologies, Metaphysics, and works of mere Imagination, are excluded from the definition.

Natural Knowledge is primarily derivable, as regards the Physical Sciences, through work (questioning of Nature) in the Observatory and Laboratory; as regards the Moral Sciences, through experience (knowledge of the World) in real life.

Illustrations from Astronomy and the Sky. Chemistry and the Crucible. Anatomy and the Dissecting Table. Jurisprudence and the Court of Justice.

Natural Knowledge is secondarily derivable through the vehicle of its Literature. To others than Specialists therefore, a Library is the most available source and depository of such knowledge.

The companionship and solace of Books.

The Literature of Natural knowledge is distinguished from other Literature by its logical method. Two such methods discernible, viz.:

Scholastic Logic—allied to authority—purely deductive and subjective.

Scientific Logic—related to research—mainly inductive and objective.

Illustrations of the logical method of authority from "the Classics," Theology, and "the Belles lettres," *e.g.*, Homer's *Iliad*, Milton's *Paradise Lost*.

Illustrations of the logical method of research from the Literature of Science, *e.g.*, Darwin's *Origin of Species* and *Descent of Man*.

Natural Knowledge is characterised by lucidity. It demonstrates an inverse ratio between Superstition and Science. It is essential for completing Culture, and conciliating Conduct into compliance with the established Order of Nature, through whose invariable laws human life is known to be inexorably governed.

Man's position in Nature, his moral constitution, and his history show, that his progress and happiness are correspondent to the cultivation of Natural Knowledge, which forms the real basis of, and security for the prosperity of our Western Civilization.

Chronological selection of Books cited in illustration of the argument of the Lecture.

The Subjective Method of Authority.

Homer's *Iliad*—Plato's *Dialogues*—Herodotus's *Grecian History*—Livy's *History of Rome*—Virgil's *Œneid*—The Works of the School-men *passim*—Pearson *on the Creed*—Milton's *Paradise Lost*—Spinoza's *Ethics*—Butler's *Analogy*—Paley's *Evidences*—Newman's *Grammar of Assent*—Matthew Arnold's *Literature and Dogma*.

The Objective Method of Research.

Aristotle's *Organon*—Archimedes *on the Sphere and Cylinder*—Thucidides' *Grecian History*—Lucretius *on the Nature of Things*—Galileo's *Dialogues on the Ptolemaic and Copernican Systems*—Bacon's *Novum Organon*—Newton's *Principia*—Malthus *on the Principle of Population*—Comte's *Philosophy Positive*—Mill's *System of Logic*—Buckle's *History of Civilization*—Maudsley's *Physiology of the Mind*—Darwin's *Origin of Species* and *Descent of Man*—Tyndall's *Heat a Mode of Motion*—Lewes's *Study of Psychology*—Huxley's *Physiography*—Herbert Spencer's *Study of Sociology*—Leslie Stephen's *Science of Ethics*.

AN HOUR IN A LIBRARY,

IN SEARCH OF NATURAL KNOWLEDGE.

ITS RELATION TO LITERATURE, TO CULTURE, AND TO CONDUCT.

IF the simple invitation of our unpretending Society to come and spend an hour in a Library, on this Sunday afternoon, even in imagination, can bring together the numerous and expectant audience whom I have the honour of addressing, we can easily appreciate the extent of the deprivation inflicted upon thousands of our fellow subjects, through the persistent resolution of the Legislature, or municipal authorities, to keep closed against them on Sundays the Public and Free Libraries established in the several large Towns throughout the Kingdom.

The reason given for this irrational, and cruel infliction, as said by some, is to diminish, or discourage Sunday labour. Why, there is probably more Sunday labour employed in taking a Bishop of the Established Church in his carriage to and fro his devotional services on a Sunday, than would suffice to keep open, and take care of the Public, or Peoples' Library in his Cathedral City, during the entire day. Others again tell us that the recreation involved in acquiring the secular information which a miscellaneous Library affords would, if indulged

in on a Sunday, be irreligious. Not "seeing," as Shakespeare told the bigots of his day—

> "Ignorance is the curse of God,
> Knowledge the wing wherewith we fly to heaven."

What is it, however, that we mean by Knowledge? In its largest sense, Knowledge may be defined as human perception of all that has been said, or done, or has happened in the World. Knowledge, so widely regarded, is at once divisible into that which is believed to be Supernatural, and that which is known to be simply Natural.

In the present day we may further say that Supernatural Knowledge is, with unimportant exceptions, embraced by Religion, whilst Natural Knowledge is almost synonymous with Science.

This division is however modern, and, until quite recently, Supernatural Knowledge would have been held to include such antiquated subjects as Witchcraft, Divination, Exorcism, Sorcery, and Magic—subjects, which, in our day, have dwindled into the phantom impostures of Spirit rapping, and Table turning, with practising which the weak and superstitious minds amongst us still divert themselves.

It is not many generations ago since it was otherwise; and, to so great an extent did the practise of what has been called 'The Black Art' prevail in this Country in the reign of Charles the 2nd, that a few intelligent persons were then induced to associate themselves together, and to found a Society for the purpose of cultivating those branches of Natural Knowledge that are based upon Observation and Experiment—what we now term the Physical Sciences; and in the year 1662 they were incorporated by the King under the style and title of 'The Royal Society;' their object being, as stated in the Charter of Incorporation, "The improvement of Natural

Knowledge"; and, from that date, we have become familiar with the distinctive appellations of Supernatural and Natural Knowledge.

But the distinction itself is far more ancient. It can be traced in Europe to remote antiquity, and we find it conspicuous in that age of enlightenment in ancient Greece, the third and fourth centuries before Christ, when the supernatural-knowledge-mongers of that day found themselves in antagonism to the natural reasonings of such powerful investigators and thinkers as Thales, Anaxagoras, Democritus, Hippocrates, Aristotle, Euclid, Apollonius, Archimedes, and some others.

Natural Knowledge, as we are now viewing it, and as distinguished from opinion, is purely the result of human observation of the facts of Nature, aided by experiment, and perfected by reasoning or reflection thereon. It is comprehended by the Physical, Mental, and Moral Sciences, such as Astronomy, Geology, Mineralogy, Chemistry, Zoology, Physiology, Psychology, and that great Moral Science Jurisprudence, which erects in civilized countries a supreme or sovereign standard for regulating the actions of man towards his fellow man, upon the basis of general justice, and equal rights before the Law.

We exclude then from our definition Religions, Theologies, Metaphysics, works of fiction and pure imagination of all kinds, and they are thus precluded from embarassing or confusing the simplicity (and I hope the clearness), of my discourse this afternoon.

Now, when we come to look into the nature of the knowledge which forms the material of the Physical Sciences, say, for example, Astronomy, Chemistry and Physiology, we find that it is not primarily derived from anything that has been simply asserted in speech or writing by men however eminent or venerable, nor from anything alleged to be a revelation from a supernatural

source, but that it consists of natural facts discovered by careful observation, or by experiment, which is indeed only observation artificially assisted by instruments invented by human ingenuity for the purpose, so to speak, of more closely questioning Nature.

To go to physical Astronomy for an illustration. Astronomical knowledge is gained primarily by carefully observing the sky through the Telescope, aided by the Equatorial, the Transit, the Sextant and other instruments, with clockwork conveniently fixed and arranged in the Observatory. By these means the existence, size, and movements, of the heavenly bodies are accurately observed, and registered. It is thus that our knowledge of a comet, for instance, has been derived.

"The blazing Star,
Threat'ning the World with famine, plague, and war!"

Verifying a startling theory propounded by Sir Isaac Newton in his Principia, the illustrious Astronomers Halley and Clairaut succeeded in discovering that Comets, appearing to move more slowly or swiftly according to the position of the Earth, must have an annual parallax, and belong to the region of the planets—that they are in truth members of our Solar System, circulating in conic sections round the Sun in rigid conformity to the universal law of gravitation, or attractive force varying directly as the mass, and inversely as the square of the distance.

Three astronomical observations taken of a Comet on its passage through space usually suffice for ascertaining its orbit, or path in the sky, and for calculating its rate of movement. If its orbit be elliptical then (an ellipse being a closed curve) the comet's return can be foretold and timed. To so great an extent have Astronomers observed and studied the appearance of Comets, that upwards of 500 of these wandering visitors have been

recorded; of them, the orbits of nearly 300 have been mathematically calculated; 19 of such orbits being elliptical, and 54 subsequent returns of comets have already been registered.

Now, through this natural knowledge of comets, the ancient terrifying superstitions respecting them, that they were ominous of the wrath of Heaven, the harbingers of wars and famines, of the dethronement of Monarchs, and the dissolution of Empires, have been completely exploded!

If Chemistry be the science under consideration, then the accurate and exhaustive analysis required to solve one of its problems can only be completely accomplished in the laboratory. Looking at Chemistry in its general sense as the science of the constitution of bodies, ascertained through the laws of composition and decomposition, *i.e.*, the modification all substances may undergo in virtue of their molecular reactions, it has for one of its chief objects really this—The properties of simple bodies being given, to find those of all compound bodies that may be formed from them. The study and practice of Chemistry therefore is a constant training of our faculties in the great art of experimentation, carried on in the furnace, the retort and the crucible, the latter being a vessel in which substances may be analysed, dissolved, or combined, by means of the application of heat.

The invaluable inventions of the science of Chemistry are sufficiently indicated in alluding to one only of its many thousand useful discoveries, viz.—hydrogen or inflammable gas, whose familiar flame is now becoming eclipsed by the superior splendour of the electric light.

If the science of Physiology is being pursued, then, as to one branch of it, a correct knowledge of the various physical constituents of the human being, such as the skin, the muscles, the veins, the arteries, and the nerves; this

is obtained through precise and minute anatomy of the human body, practised in the dissecting room. I will illustrate this by reference to the serious malady known as the aneurism of an artery (a tumour formed by its morbid enlargement).

Until recent times this formidable, and mostly fatal, disease was very rarely cured, without amputation of the limb in which the artery was situate; but now, owing to an acute discovery made by the consummate anatomist John Hunter, practically followed up by the great surgeon Abernethy, a successful operation is performed, consisting of tying the artery at a distance from the sac of the aneurism the seat of the disease, instead of cutting into it, whereby the arterial blood, whose continuous flow prevents the cure, is diverted into other channels, and, by this apparently simple expedient, thousands of lives have been saved. But observe, neither a correct diagnosis of the disease, nor the successful method of curing it could have been arrived at otherwise than through that actual contact of the intelligent sense of man with the physiological facts of Nature that takes place in the manual process of dissection.

So far the physical sciences; but the same principle underlies our knowledge of the mental and moral sciences.

To take an illustration from that grandest of the moral sciences, Jurisprudence or the science of Law, the pride (as it has been called) of the human intellect, which, with all its defects, redundances and errors, is the collected reason of ages, combining the principles of original justice with the infinite variety of human concerns—"A science in which the greatest powers of understanding are applied to the greatest number of facts."

On first impression it would appear that Law is a science of a purely literary character. A Law library

would be supposed to comprise all that was necessary to be known upon the subject. In truth however, it is so far otherwise, that it would hardly be possible for anyone correctly to comprehend a single legal treatise, unless he had been educated to the law ; an essential part of a legal education consisting in the actual experience derived from practice in personally attending Courts of justice, and there becoming familiar with human nature itself, in that phase of real life, where it must be studied in the characters, the habits, and peculiarities of Judges, Jurymen, Counsel, and Witnesses.

In that grand epoch of history, when the physical and moral sciences were experiencing, as it were, a new birth, that period, when, in our country, we boasted the great names of Spenser, Shakespeare, Bacon, Harvey, and Hooker, the revival of the science of the law was not behindhand, and in the name of Lord Chief Justice Coke we have one of the most profound and scientific lawyers of which even this great and free country (where the certainty and impartiality of the law are rightly reverenced as the guarantee of real freedom) is so justly proud. Lord Coke, in his first Institute, (familiarly known in legal circles, as 'Coke upon Littleton') expressly points out to the law-students that, though law is indeed the very perfection of reason, "that must be understood, not as every man's undisciplined reason but, as the reason gotten by long study, observation, and experience, which will be gained, when he heareth a case vouched and applied in Westminster Hall, where it is necessary for him to be a diligent hearer and observer of cases of law."

Scientific knowledge then we see is primarily derivable from Nature herself. It is not obtained at first hand from literature, and no one can become a real specialist in any science without the faculty or practice of appealing directly to Nature, and acquiring, through the medium

of his senses, actual knowledge or touch of those properties of things which are only derivatively learnt through the medium of language.

Science then, you observe, is a knowledge of things rather than a knowledge of books.

Now of the indispensable acquisition of such knowledge towards the perfecting of human life the mere literary world is apparently, even yet, in a state of unconscious ignorance.

Professor Matthew Arnold, in the course of his brilliant Rede Lecture, lately delivered before the University of Cambridge, told that learned assembly that, his studies having been almost wholly in letters, his visits to the field of the Natural Sciences had been very slight and inadequate, although, he naïvely observed, those sciences strongly moved his curiosity. This remarkable utterance was quite in the spirit of the old classical culture.

I trust that I have been able to place the nature of scientific knowledge sufficiently before you, even in the few observations time permits me now to make, as to impress you with the conviction that the Natural Sciences are something more than mere matters of curiosity. They are indeed subjects of the very highest concern to the daily life of our modern civilization. One would have thought that their utility or vast practical advantage was by this time obvious to the merest tyro, as well as their wide influence in strengthening and raising up the intellectual and moral faculties of our understanding, by emancipating human existence from the pressure of debasing superstitions, from whose stupefying terrorism, not the Classics, nor Letters, nor the finical culture that is bred solely of them, but, the rise and progress of Natural Knowledge have now so effectually freed it.

It would however be a sad look out for the world at large, if no one could hope to obtain Natural Knowledge

excepting in the Observatory and Laboratory, where comparatively few can enter, and, in truth, the diffusion of such knowledge is really carried on derivatively through the vehicle of Literature; consisting chiefly of those treatises on Scientific Knowledge which we owe to the Men of Science themselves, whose humane desire to enlighten and benefit their fellow creatures has invariably led them to seek to disseminate their special knowledge by writing books about it; and therefore, it is undoubtedly the fact, that to the intelligent general reader, that is, to all who are not specialists, and to specialists themselves, in all branches of Natural Knowledge in which they are not specialists, a library is the available source and depository of such knowledge. And so it has come to pass that the thirst for knowledge is most usually gratified through the passion or taste for reading, and books come to be rightly regarded as the readiest sources of information. And such is the genuine pleasure arising from acquiring knowledge of any sort, that books in all their variety are by everyone more or less resorted to for solace or amusement, as well as for instruction, and they yield, to the dwellers in cities especially, and to the sons and daughters of toil, for the most part innocent and elevating recreation.

> "Books beloved, ye are to me
> An unretorting family.
> Ye for each day's irritation,
> Always bring a compensation,
> Curing all sad perturbations
> With your silent inspirations.
> How should sadness come, or gloom,
> While ye lie about my room,
> Or look down from friendly nooks?
> My benison upon ye, Books."

We now approach a very interesting and instructive characteristic, which separates, almost by a sharp line, the literature embodying Natural Knowledge, from literature

of every other kind. I am alluding to the intellectual method upon which it is composed.

Looking at literature or books in the mass, we easily distinguish two very distinct logical methods of literary composition—the one method, which I will call the method of authority, characterises all books which are written on the principle of taking for granted, or on the authority of ancient or individual assertion or opinion or belief, the ultimate premises from which the reasonings and discussions contained in them are deduced, and this method may therefore be described as the deductive method; then, as the facts and arguments are drawn from the human mind, rather than from external Nature, the method in question may also be fitly called subjective.

This deductive and subjective logical method will be found to underlie more or less all literature, with the exception of the literature relating to Natural Knowledge.

The other logical method, which I will call the method of research, is remarkably different from the method of authority. In the method of research the premises of a dissertation or discussion are not taken from human assertion, or opinion or belief, however ancient or venerable, or from the intuitions of the mind, but, from those facts of nature which have been derived from the study of Nature herself, and are traceable to the verification or stamp of truth that has been impressed upon them in the Observatory or Laboratory; that is, the premises from which the reasoning proceeds have been obtained by the process of induction. The method therefore may be described as the inductive method, and, as the premises have not been drawn from the human mind, but from the observation and interrogation of Nature, the method now being characterised may also be fitly called objective.

Now the opposition I am pointing out, between the deductive subjective method of authority, and the inductive objective method of research, is not simply a dialec-

tical distinction, it is one of substance, and of great moment; for I may without hesitation assert that, though the old logic of authority is ever multiplying opinions, it has never produced any increase of real knowledge, or brought about the discovery of new truth, nor has it ever practically resulted in relieving one pang of pain, or in lifting an ounce of the burden of human misery; whilst, on the other hand, the modern logic of research has made, by means of its marvellous discoveries, a considerable share of material comfort the common heritage of all civilized men.

I could make this quite plain to you, as well as greatly increase the interest of the subject, by giving you various illustrations from almost the entire realm of literature. You will observe in my syllabus (which is I hope in your hands) that I have drawn up two lists of books respectively cited in support of this argument. These lists may perhaps appear to some of you rather formidable, whilst to others of you, especially those who might be disposed to dispute my propositions, they may appear altogether too meagre, whilst there are among you others who would probably make a somewhat different choice.

Well, you will not forget that we are now supposed to be assembled in a Library, and that, in the mind's eye, we see around us many thousands of volumes, which, being the depository of the thoughts of mankind, contain much wisdom, and also many absurdities, some things that are true, but a great many that are false. Hence it is, that book knowledge is not always real knowledge. My task therefore is one of search and of selection, and, bearing in mind, that I am speaking within the compass of an hour, such selection is necessarily very restricted, assisted, though I am, by this admirably classified Catalogue of the Library of the Royal Institution. I think however the books cited will be found sufficient in number and character for my purpose. At any rate they comprise on

either side several of the acknowledged masterpieces of the human mind.

Everyone present is, I feel sure, more or less familiar with some of them. Who, for instance, has not felt the stirring strains of old Homer's Iliad, even through the medium of a translation? That exciting episode in the siege of Troy—

> "Achilles' wrath, to Greece the direful spring
> Of woes unnumbered . . . .
> That wrath which hurled to Pluto's gloomy reign
> The souls of mighty chiefs untimely slain."

Who again has not been moved by Milton's melodious muse, which in "Paradise Lost" sings so sacredly, (however superstitiously)—

> "Of man's first disobedience and the fruit
> Of that forbidden tree, whose mortal taste
> Brought death into the world, and all our woe,
> With loss of Eden, 'till one greater man
> Restore us, and regain the blissful seat."

Probably too, the youngest lad amongst us this day has had his mind indirectly illuminated, thanks to our Board Schools, by a knowledge more or less of those transcendent truths of Nature, which radiated originally from the sublime cosmical conception of Copernicus, or the glorious and immortal Principia of Sir Isaac Newton.

Well then, to save our time I think I may suggest to you that, without further particular reference to my array of books, I should be allowed to take them as read, and so be enabled to proceed to make a few observations upon one or two of them.

Returning then to the grand epic of Homer, we find that its exquisite verse, its dramatic force of incident, its exuberant invention, its marvellously realistic descriptions of the characters, manners and customs of the ancient Grecians, and its abounding literary graces are all, from the point of view of Natural Knowledge, tarnished by

their intimate association with the false and sensual mythology of the ancient heathens, a mythology that strikes our rational minds with astonishment, when we find it related that battles are encouraged or interfered with by Gods and Goddesses descending to the Earth, and ensuring victory or defeat by enveloping the combatants in clouds, or, sometimes, by dragging them bodily away from their enemies.

Then again, when we read, that during the Siege of Troy epidemic fever wasted the Grecian Camp, the God Apollo is presumed to have been offended, and the remedy is sought in some sacerdotal sacrifice to appease him. In our day, during the Siege of Sebastopol epidemic fever also wasted the British Camp, but the remedy was sought in better ventilation and improved drainage. No superstitious priesthood were implored to propitiate an angry God, but scientific physicians prescribed that doses of quinine should be administered to the suffering soldiers.

Turning to the majestic numbers of Milton we find them for the most part marred in like manner. In the poem of Paradise Lost we may observe a remarkable analogy of ideas with the poem of the Iliad. In both there is the same association of the story and its heroes with supernatural agencies. In the one, the Iliad, the supernatural machinery is that of the mythology of the ancient Greeks. In the other, the Paradise Lost, the supernatural machinery is that of the mythology of the semi-barbarous Hebrews.

But, what I desire to call your attention to is, the different effect produced on our minds by the perusal of these two magnificent epic poems.

We have been educated to ignore, to despise, and to laugh at the heathen religions of the ancient Classical World, and we only smile amused when we read in Homer's Iliad that, in the very crisis of the mortal combat

between Menelaus and Paris, and as the latter is on the point of being throttled by the former's grip of his helmet's band—

> "Then had his ruin crown'd Atrides' joy
> But Venus trembled for the Prince of Troy.
> Unseen she came, and burst the golden band,
> And left an empty helmet in his hand.
> The Queen of Love her favored champion shrouds
> (For Gods can all things) in a veil of clouds."

On the other hand, we have been brought up from infancy to believe as positively true the semitic superstitions of the semi-barbarous Hebrews, and those, whose credulity still compels them to accept such superstitions as the scheme of a living religion, seriously read in Milton's Paradise Lost, without being shocked at its amazing absurdity, how an imaginary supernatural evil power, an arch-fiend termed Satan—"Prince and Chief of many throned Powers, that led the embattled Seraphim to war"—actually entered, first into the body of a cormorant, and then, into that of a serpent, in order to tempt Eve to eat of the forbidden fruit. How she, meditating on such temptation, thus reflects—

> . . . . . "In the day we eat
> Of this fair fruit, our doom is, we shall die.
> How dies the Serpent? He hath eaten, and lives,
> And knows, and speaks, and reasons, and discerns,
> Irrational till then. For us alone
> Was death invented? Or to us denied
> This intellectual food, for beasts reserved?
> . . . . . This fruit divine,
> Fair to the eye, inviting to the taste,
> Of virtue to make wise. What hinders then
> To reach, and feed at once both body and mind?
> So saying, her rash hand in evil hour
> Forth reaching to the fruit, she pluck'd, she eat!
> Earth felt the wound; and Nature, from her seat,
> Sighing through all her works, gave signs of woe,
> That all was lost!"

Now, from this difference in our early training in respect of the mythologies referred to, the grand poem of Homer has probably been a source of intelligent interest, of unalloyed pleasure, and of innocent instruction to its millions of modern readers, whilst the study of the grand poem of Milton has probably done more to obstruct the progress of Natural Knowledge, and to intensify the Mosaic superstitions enshrined in its harmonious numbers, than all the reading of the book of Genesis; the magic influence of its fascinating fable overwhelming the reason of its reader, whilst enchanting his enraptured and spell-bound imagination.

To the student of Natural Knowledge the respective mythologies of the ancient Greeks and the semi-barbarous Hebrews are, in point of historical credibility, about on a par, and they are alike by him regarded as the probable product of that credulous condition of the emotional faculties of fear and wonder, as they existed in the dawning intelligence, and dazed imagination of primitive barbarian man. Our knowledge of such childhood of religions is however quite recent, and for much of it we are indebted to the sceptical and truth-seeking minds of critical scholars still living amongst us.

When Bishop Colenso, one of the greatest biblical critics of the present age, published his profound work on the Pentateuch, he had to deplore the dense prejudices and superstitions of the half-educated classes in this country, who seemed to be positively incapable of comprehending his thorough exposure of the errors, the absurdities, and the contradictions to science contained in the book of Genesis, and the other earlier books of the Bible; but, he remarks in one of the prefaces to his learned work, that the opposition his views had to encounter was evidently not derived from any actual knowledge his assailants had of the Bible itself (which they had never probably read,

except through the spectacles of their theology) but that it for the most part proceeded from the fact of their having been saturated in early youth with the poems of Milton. We, observed Colenso, literally groan, even in the present day, under the burden of Milton's mythology.

Now, the spirit of the remarks I have been making on the poems of Homer and Milton is really applicable, in various degree, to all literature that has been composed and written on the subjective method of authority. That is to say, so much of it is mere imagination, or is taken for granted, or is assumed without evidence or due verification through the reason, that you have no guarantee whatever for its objective truth, and it is in fact all more or less blended with fictions or fallacies, or irrational beliefs of one kind or another.

Turning now to the literature of Science, which is the result of the unprejudiced search into Nature, which founds its reasonings and inferences exclusively upon the natural facts that have been arrived at through the observation and questioning of Nature, which assumes nothing, takes nothing for granted, and declines to adopt human assertion or belief however venerable or authoritative, without its having been duly verified by an appeal to Nature, we shall come upon some very striking differences from the class of literature we have just been engaged upon.

As an apposite illustration of such differences, I will, from my list of books, very briefly direct your attention to the two principal works of our late illustrious Vice-President, Charles Darwin—'*The Origin of Species*' and '*The Descent of Man.*'

These memorable monographs are amongst the finest examples of scientific literature in our language. Their superstructure is erected upon a massive foundation of natural facts, their generalisations are based upon induc-

tions from a vast survey and cross-examination of most various premises, their reasonings are ethical as well as logical, that is, they everywhere evince an ardent desire to arrive at truth, and a conscientious care to distinguish certainties from probabilities, and never to press the latter beyond their legitimate weight.

We have all heard and read a great deal about Charles Darwin since his surprising and impressive funeral in Westminster Abbey; when the Church, which had so reviled him whilst living, solemnly recanted at his grave. With her Cathedral Service sanctifying the truth of his astonishing discoveries, and in her choral anthem's swelling peal, confessing—

"Happy is the man that findeth wisdom, and getteth understanding.

"She is more precious than rubies, and all the things thou canst desire are not to be compared unto her.

"Length of days is in her right hand, and in her left hand riches and honour.

"His body is buried in peace, but his name liveth evermore!"

Our accomplished Vice-President Dr. Richardson recently gave us a most interesting lecture upon Charles Darwin, but even the capacity of Dr. Richardson could not exhaust so fertile a theme as the works of Darwin in a single lecture, and I think that the way in which I will try to present to you the grand genius and brilliant discoveries that have encircled the name of Darwin with the halo of world-wide renown, may have a freshness to many of you even yet.

Now it is remarkable that there has never been any great intellectual discovery which, when it came to be known, and looked at historically, that is in connection with the previous knowledge existent at the time of such discovery, has not appeared to have been, to a great extent, anticipated by previous discoveries. This has been the case with respect to Lord Bacon's Novum Organon;

it was so in reference to the startling cosmical conception of Copernicus; it was so with the discoveries of Galileo; with that of the circulation of the blood by William Harvey; with the discovery of universal gravitation by Newton; with that of the functions of the brain by Dr. Gall; and with others I could mention; and it has been so with regard to the discoveries of Charles Darwin, as we indeed heard from Dr. Richardson, and as you will presently hear further from me.

The truth would seem to be, that Natural Knowledge, or the human discovery of new truth, does not proceed by leaps and bounds, but only by small or graduated steps throughout the effluxion of time.

The existing state of knowledge and opinion on the subject of Darwin's great work '*The Origin of Species*,' at the time when its appearance took the scientific world captive by its overpowering force and originality, may be very briefly stated. I am now of course going to speak as little in the language of technical science as possible, and the term 'Species,' so bewildering in its zoological and botanical variety, may, for our present purpose, be taken as meaning, the commonly distinguished classes of individuals composing the animal and vegetable kingdoms, *i.e.*, the several kinds of Beasts, Birds, Reptiles, Fishes, Insects, Plants, and Flowers.

Up to a comparatively recent period all such individuals were supposed to be the *fac simile* descendants or copies of those of like kind which had been suddenly, that is within a period of six days, brought into existence at the Creation, as described in the Book of Genesis, and subsequently, when the flood came, preserved in Noah's Ark. That from such time to the present there had been no variation in them, and, to those who believed this (chiefly the theological world), the invariability or fixity of Species was simply a dogma.

The noble Science of Geology however had very rudely disturbed this belief, and it had shown, more especially in the masterly works of our late deceased member Sir Charles Lyell, that, amongst other matters, millions of species, altogether different from those now in existence, had at various times in past ages inhabited this earth, and that, if they had been created at all, such creation must have occupied ages in the process, and most certainly did not take place in the order, any more than in the time, described in the Book of Genesis—Genesis in brief, from the point of view of Geological Science, stood absolutely discredited: and the mind of man, being freed from the shackles of the Mosaic Cosmogony was left at liberty to investigate when and how all this enormous amount and apparent waste of life originated.

The most rational scientific hypothesis on the subject, the credit of which is chiefly due to the illustrious French naturalist Lamarck, was simply that, existing species were not copies, but were the modified or transformed descendants of previous species that had died out, such modification having arisen by changes singly imperceptible, but perpetually accumulating throughout the enormously long period of time, during which it was proved by geological monuments that life in its various extinct forms had existed on this earth. Hence the scientific world had come firmly to believe in the new doctrine of the variability or transmutation of Species.

Now, in this diverse condition of knowledge and opinion, the startling effect produced by the publication of Darwin's great work was the result of his having not only thereby confirmed the scientific view of the transmutation of species, by the marvellous assemblage of natural facts which he had collected and classified on the subject by years of travel, voyage, and intellectual toil, including most interesting experiments conducted by

himself in the selective breeding of pigeons (altogether amounting to a resistless accumulation of proofs), but, by his having shown with all the clearness of his consummate genius actually how and why such transmutation must have taken place.

That is to say, he first pointed attention to the remarkable fact which, if previously known, had not hitherto been correctly appreciated, viz.—that Nature, in every species of life, produces a vast number of individuals in excess of those for whom there is or can be subsistence. That this vast number so produced must therefore perish—That in fact they do perish, but not without a struggle or food-scramble—A battle for life everywhere ensues, in which, Darwin acutely inferred, the strongest or most capable must conquer and live, whilst the weakest will be defeated and die. This striking discovery Darwin luminously defined as 'Natural Selection,' or survival of the fittest. Darwin then drew particular attention to his sagacious inference that the survivors must have had superior qualities, as evidenced by their victory in the battle, and that, in virtue of the known natural law of hereditary transmission and adaptation, such superior qualities would be more or less transmitted to their offspring. In the next ensuing struggle there would be then a further natural selection amongst these, and another survival of the fittest of them; and this struggle and survival ever repeating itself in the course of almost endless generations of such transitional forms, a divergence of superiority or improved modification, though at first scarcely perceptible, would become so augmented by gradual development as to cause the production, naturally, of all the various species now existing amongst us, from predecessors so remote as to be utterly different from them in nearly every conceivable characteristic; so that, for example, Birds would really be the

modified or transformed descendants of Reptiles; a conception which, however difficult of realisation by our minds, has now been established as a natural fact through the original research of Professor Huxley who, guided by Darwin's theory, has actually spotted 'the missing link' in the remains of a creature that was, when living, half a Bird and half a Reptile!

I will further concisely illustrate the process and meaning of Natural Selection as discovered by Darwin by a brief reference to the eye, our organ of sight. In some of the early struggles for existence occurring ages ago amongst the low organisms obtaining their food chiefly by the use of their eyesight, those individuals which had the best power of vision would be those best enabled to live, and would naturally be the survivors; and the almost endless repetition of such struggles occurring in the course of ages, by successive and minute stages of improvement in the visual organ would naturally and inevitably result in the present perfection of the eye.

Now the animal kingdom, aided by geological research, brings before us a series of creatures, in whom can be traced by comparative anatomy, a regular, graduated, and successive improvement in the mechanism, range, and power of their eyesight, slowly evolved in the lapse of enormous periods of time; whereby the eye, from being in the lowest animal a simple spot of pigment incapable of even reflecting images of external objects, and at most distinguishing different rays of light, has at length developed into the marvellously complex and exquisitely perfect apparatus for sight that we living now possess and enjoy.

These enormous periods of time I am referring to are, by some minds, very difficult to realise, and are held to be obstacles to belief in Darwin's theories—That is to say, people do not reflect, that however enormously long

a lapse of time the human mind would, or can conceive, it is but a span in comparison with eternity, which both precedes and follows it.

My observations on the other great work of Darwin '*The Descent of Man*' need not detain us long. Although it was not obvious to the popular mind that the facts and reasonings of the essay on '*The Origin of Species*' must equally apply to the Origin of Man himself, no scientific investigator of the subject could have had any doubt about it; but the publication of '*The Descent of Man*' brought the whole subject home to the general reading public, and raised a perfect storm of dissent and disapprobation, showing how little the views of its illustrious author, as expounded in '*The Origin of Species*,' had been comprehended, or reflected upon.

The question raised was simply this—when and how did Man make his first appearance on our Planet? It was proved by Geological research that the Earth, and animal life upon its surface had existed for ages before man's appearance.

The only specific account we have of man's origin is that contained in the book of Genesis, which tells us that he was made from the dust of the Earth. But the scientific authority of that book had been, as I have observed, utterly discredited, and the human mind had been set free to enquire and reflect upon the matter.

Now, the alternative put forward by Darwin was very briefly this—Due regard being had to what is known geologically, zoologically, and embryologically of the ascending gradations of animal life, including especially the developmental changes in the embryo of man himself, it is as certain as reasoning from such premises can make it, that man is the evolution or development of lower animal forms. Such evolution or development having taken place gradually throughout the succession of a long course

of ages, during which such lower animal forms, by the continued constant struggle for existence and survival of the fittest, were slowly and gradually acquiring all those superior attributes, qualities and characteristics, more especially those we term mental, that at length culminated in the production of a creature viz., primeval savage barbarous man; a being distinguishable in degree rather than in kind from his immediate animal parents, from whom he probably differed less than he would be found to differ from his civilized European descendant of the present day; and that such descent, or, one might say, ascent, from the lower animal life, was the true natural pedigree of Man.

I told you just now that you would hear also from me by whom Darwin's discoveries had been to some extent anticipated, and I will single out one who was named by the modest and candid mind of Darwin himself as having, in a very remarkable and original work, pointed out to him the constant fact of the ever continuing struggle or intense competition for the means of subsistence, owing to the vastly greater number of individuals Nature, uncontrolled by human intelligence, brings into existence, than can possibly be provided for. It is the name of one whose profound and truthful views have had to contend against, and have nearly been suppressed by, the prejudices and superstitions of the age in which he lived; but I will here describe him as a discoverer who will certainly in due time be recognised as one of the greatest benefactors of our race. It is to the celebrated *Essay on the Principle of Population in its relation to Human Happiness*, written by the benevolent Malthus, that Darwin states he was indebted for his knowledge of the principle underlying the discoveries of his own great works, and I will venture now to say, that sooner or later it will be acknowledged that not the least of the services rendered

to mankind by the illustrious Darwin has been his corroboration and elucidation of the profound and important truths enunciated by the scarcely less illustrious Malthus —when it will come to be generally known that the discoveries of Malthus and Darwin have in reality effected for our knowledge of the Order of Nature in the organic Kingdom, what, in a manner somewhat similar, the discoveries of Copernicus and Newton effected for our knowledge of the Order of Nature in the inorganic Kingdom.

We are now, I think, in a position to point out several characteristics of Natural Knowledge. Its most striking peculiarity in relation to other knowledge is its lucidity. It is truth, and truth of the clearest and simplest kind. Nature, when questioned, answers, not evasively or ambiguously, but in the most direct and positive manner. She does not express herself with that confusion or obscurity of ideas and language which are found more or less pervading the literary lucubrations of man.

Natural Knowledge, as the verified basis of conscientious Belief, also exhibits to us the antagonism existing between Superstition or assumed manifestations of the Supernatural, and Science, and enables us to formulate as an axiom—'*The more Natural Knowledge, the less Superstition.*'—No Culture then can be complete without Natural Knowledge, which is indeed its better part, as seems obvious on the slightest reflection—For what should we understand by culture? It has been defined by its chief apostle as, "Knowing (through literature) the best that has been thought and said in the world." That is, I submit to you, an imperfect definition, though it necessarily includes some library knowledge of Science, since it would be difficult to find anything in the world really better than what Science has revealed to us. For Science has shown us that Nature is the expression of a definite

order, or invariable succession of phenomena, termed laws of Nature, with which nothing interferes, and that man, to exert his full powers, and to live uprightly and happily, must master that order, and govern himself accordingly; and thereby Science has added to the conventional definition of culture, by compelling it to include such a discipline of the human mind in scientific method as will teach it to rise superior to Superstition, and so instruct man to regard as his highest duty the regulation of his conduct in obedience to the dictates of the natural moral law.

Natural Knowledge therefore is not a knowledge merely of physical inorganic Nature, but it comprises that knowledge which is the result of our enquiries into the nature of man himself, his moral and social constitution, and its relations to his environment; and, if we turn to the records of the history of civilized communities, we find, that, separating the actual knowledge men have possessed from their superstitious beliefs, we are enabled to trace such happiness and progress as they have enjoyed to their real source in the cultivation of Natural Knowledge.

It is the increase and spread of such knowledge, and the inventions and discoveries that have arisen from man's study and interrogation of Nature—the true, the useful, and the practical—that distinguish, in so remarkable a manner, the modern nations of Europe from the barbarous and classical nations of antiquity, and there can be no doubt that Theologies and Metaphysics, with their endless and confusing jargons and their senseless beliefs, have decayed and are dying out, in proportion as the culture of Natural Knowledge has increased and is increasing; whereby human progress, not only in individual or selfish happiness, but in the recognition of right or humanity towards every member of the great human family, has advanced, has become vivified, and is being

practically acted upon; so that the secular moral virtues Veracity and Justice are at last gradually becoming the universally accepted criterion of Conduct, the acknowledged standard of human actions.

Finally it is this Natural Knowledge that forms the sure basis of, and affords the most effectual security for the stability and prosperity of that enlightened and rationally regulated Liberty, which, in contrast with the ignorance, the superstition, the slavery, and the inhumanity of Barbarism, Classicism, Mediævalism, and Orientalism, is so significantly termed—OUR WESTERN CIVILIZATION.

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