

**Chapter 1 : Science and Culture ()**

*Science and Culture () Collected Essays III [] Six years ago, as some of my present hearers may remember, I had the privilege of addressing a large assemblage of the inhabitants of this city, who had gathered together to do honour to the memory of their famous townsman, Joseph Priestley; 1 and, if any satisfaction attaches to posthumous glory, we may hope that the manes of the burnt-out.*

Hence I am disposed to think that, if Priestley could be amongst us to-day, the occasion of our meeting would afford him even greater pleasure than the proceedings which celebrated the centenary of his chief discovery. The kindly heart would be moved, the high sense of social duty would be satisfied, by the spectacle of well-earned wealth, neither squandered in tawdry luxury and vainglorious show, nor scattered with the careless charity which blesses neither him that gives nor him that takes, but expended in the execution of a well-considered plan for the aid of present and future generations of those who are willing to help themselves. We shall all be of one mind thus far. In the last century, the combatants were the champions of ancient literature, on the one side, and those of modern literature on the other, but, some thirty years ago, the contest became complicated by the appearance of a third army, ranged round the banner of physical science. I am not aware that any one has authority to speak in the name of this new host. For it must be admitted to be somewhat of a guerilla force, composed largely of irregulars, each of whom fights pretty much for his own hand. But the impressions of a full private, who has seen a good deal of service in the ranks, respecting the present position of affairs and the conditions of a permanent peace, may not be devoid of interest; and I do not know that I could make a better use of the present opportunity than by laying them before you. From the time that the first suggestion to introduce physical science into ordinary education was timidly whispered, until now, the advocates of scientific education have met with opposition of two kinds. On the one hand, they have been poohpoohed by the men of business who pride themselves on being the representatives of practicality; while, on the other hand, they have been excommunicated by the classical scholars, in their capacity of Levites 3 in charge of the ark of culture and monopolists of liberal education. The practical men believed that the idol whom they worship -- rule of thumb -- has been the source of the past prosperity, and will suffice for the future welfare of the arts and manufactures. They were of opinion that science is speculative rubbish; that theory and practice have nothing to do with one another; and that the scientific habit of mind is an impediment, rather than an aid, in the conduct of ordinary affairs. I have used the past tense in speaking of the practical men -- for although they were very formidable thirty years ago, I am not sure that the pure species has not been extirpated. His spiritual wounds, such as are inflicted by logical weapons, may be as deep as a well and as wide as a church door, but beyond shedding a few drops of ichor 4 , celestial or otherwise, he is no whit the worse. So, if any of these opponents be left, I will not waste time in vain repetition of the demonstrative evidence of the practical value of science; but knowing that a parable will sometimes penetrate where syllogisms fail to effect an entrance I will offer a story for their consideration. Once upon a time, a boy, with nothing to depend upon but his own vigorous nature, was thrown into the thick of the struggle for existence in the midst of a great manufacturing population. He seems to have had a hard fight, inasmuch as, by the time he was thirty years of age, his total disposable funds amounted to twenty pounds. Nevertheless, middle life found him giving proof of his comprehension of the practical problems he had been roughly called upon to solve, by a career of remarkable prosperity. Finally, having reached old age with its well-earned surroundings of "honor, troops of friends," the hero of my story bethought himself of those who were making a like start in life, and how he could stretch out a helping hand to them. After long and anxious reflection this successful practical man of business could devise nothing better than to provide them with the means of obtaining "sound, extensive, and practical scientific knowledge. I need not point the moral of a tale which, as the solid and spacious fabric of the Scientific College assures us, is no fable, nor can anything which I could say intensify the force of this practical answer to practical objections. We may take it for granted then, that, in the opinion of those best qualified to judge, the diffusion of thorough scientific education is an absolutely essential condition of industrial progress; and that the college which has been opened to-day will confer an

inestimable boon upon those whose livelihood is to be gained by the practice of the arts and manufactures of the district. The only question worth discussion is, whether the conditions, under which the work of the college is to be carried out, are such as to give it the best possible chance of achieving permanent success. Sir Josiah Mason, without doubt most wisely, has left very large freedom of action to the trustees, to whom he proposes ultimately to, commit the administration of the college, so that they may be able to adjust its arrangements in accordance with the changing conditions of the future. But, with respect to three points, he has laid most explicit injunctions upon both administrators and teachers. Party politics are forbidden to enter into the minds of either, so, far as the work of the college is concerned; theology is as sternly banished from its precincts; and finally, it is especially declared that the college shall make no provision for "mere literary instruction and education. But the third prohibition brings us face to face with those other opponents of scientific education, who are by no means in the moribund condition of the practical man, but alive, alert, and formidable. It is not impossible that we shall hear this express exclusion of "literary instruction and education" from a college which, nevertheless, professes to give a high and efficient education, sharply criticised. Certainly the time was that the Levites of culture would have sounded their trumpets against its walls as against an educational Jericho. How often have we not been told that the study of physical science is incompetent to confer culture; that it touches none of the higher problems of life; and, what is worse, that the continual devotion to scientific studies tends to generate a narrow and bigoted belief in the applicability of scientific methods to the search after truth of all kinds. How frequently one has reason to observe that no reply to a troublesome argument tells so well as calling its author a "mere scientific specialist. For I hold very strongly by two convictions. The first is, that neither the discipline nor the subject-matter of classical education is of such direct value to the student of physical science as to justify the expenditure of valuable time upon either; and the second is, that for the purpose of attaining real culture, an exclusively scientific education is at least effectual as an exclusively literary education. I need hardly point out to you that these opinions, especially the latter are diametrically opposed to those of the great majority of educated Englishmen, influenced as they are by school and university traditions. In their belief, culture is obtainable only by a liberal education; and a liberal education is synonymous, not merely with education and instruction in literature, but in one particular form of literature, namely, that of Greek and Roman antiquity. They hold that the man who has learned Latin and Greek, however little, is educated; while he who is versed in other branches of knowledge, however deeply, is a more or less respectable specialist, not admissible into cultured caste. The stamp of the educated man, the university degree, is not for him. Arnold tells us that the meaning of culture is "to know the best that has been thought and said in the world. That criticism regards "Europe as being, for intellectual and spiritual purposes, one great confederation, bound to a joint action and working to a common result; and whose members have, for their common outfit, a knowledge of Greek, Roman, and Eastern antiquity, and of one another. Special, local, and temporary advantages being put out of account, that modern nation will in the intellectual and spiritual sphere make most progress, which most thoroughly carries out this programme. And what is that but saying that we too, all of us, as individuals, the more thoroughly we carry it out, shall make the more progress? The first, that a criticism of life is the essence of culture; the second, that literature contains the materials which suffice for the construction of such a criticism. I think that we must all assent to the first proposition. For culture certainly means something quite different from learning or technical skill. It implies the possession of an ideal, and the habit of critically estimating the value of things by comparison with a theoretic standard. Perfect culture should apply a complete theory of life, based upon a clear knowledge alike of its possibilities and of its limitations. But we may agree to all this, and yet strongly dissent from the assumption that literature alone is competent to supply this knowledge. After having learnt all that Greek, Roman, and Eastern antiquity have thought and said, and all that modern literatures have to tell us, it is not self-evident that we have laid a sufficiently broad and deep foundation for the criticism of life which constitutes culture. Indeed, to any one acquainted with the scope of physical science, it is not at all evident. Considering progress only in the "intellectual and spiritual sphere," I find myself wholly unable to admit that either nations or individuals will really advance, if their common outfit draws nothing from the stores of physical science. I should say that an army, without weapons of precision, and with no particular base of

operations, might more hopefully enter upon a campaign on the Rhine, than a man, devoid of a knowledge of what physical science has done in the last century, upon a criticism of life. When a biologist meets with an anomaly, he instinctively turns to the study of development to clear it up. The rationale of Contradictory opinions may with equal confidence be sought in history. It is, happily, no new thing that Englishmen should employ their wealth in building and endowing institutions for educational purposes. But, five or six hundred years ago, deeds of foundation expressed or implied conditions as nearly as possible contrary to those which have been thought expedient by Sir Josiah Mason. That is to say, physical science was practically ignored, while a certain literary training was enjoined as a means to the acquirement of knowledge which was essentially theological. The reason of this singular contradiction between the actions of men alike animated by a strong and disinterested desire to promote the welfare of their fellows, is easily discovered. At that time, in fact, if any one desired knowledge beyond such as could be obtained by his own observation, or by common conversation, his first necessity was to learn the Latin language, inasmuch as all the higher knowledge of the western world was contained in works written in that language. Hence, Latin grammar, with logic and rhetoric, studied through Latin, were the fundamentals of education. With respect to the substance of the knowledge imparted through this channel, the Jewish and Christian Scriptures, as interpreted and supplemented by the Romish Church, were held to contain a complete and infallibly true body of information. Theological dicta were, to the thinkers of those days, that which the axioms and definitions of Euclid are to the geometers of these. The business of the philosophers of the Middle Ages was to deduce from the data furnished by the theologians, conclusions in accordance with ecclesiastical decrees. And if their demonstrations fell short of or exceeded this limit, the Church was maternally ready to check their aberrations, if need be, by the help of the secular arm. Between the two, our ancestors were furnished with a compact and complete criticism of life. They were told how the world began and how it would end; they learned that all material existence was but a base and insignificant blot upon the fair face of the spiritual world, and that nature was, to all intents and purposes, the playground of the devil; they learned that the earth is the centre of the visible universe, and that man is the cynosure of things terrestrial; and more especially is it inculcated that the course of nature had no fixed order, but that it could be, and constantly was, altered by the agency of innumerable spiritual beings, good and bad, according as they were moved by the deeds and prayers of men. The sum and substance of the whole doctrine was to produce the conviction that the only thing really worth knowing in this world was how to secure that place in a better, which, under certain conditions, the Church promised. Our ancestors had a living belief in this theory of life, and acted upon it in their dealings with education, as in all other matters. Culture meant saintliness -- after the fashion of the saints of those days; the education that led to it was, of necessity, theological; and the way to theology lay through Latin. That the study of nature -- further than was requisite for the satisfaction of everyday wants -- should have any bearing on human life was far from the thoughts of men thus trained. And, if any born scientific investigator followed his instincts, he might safely reckon upon earning the reputation, and probably upon suffering the fate, of a sorcerer. Had the western world been left to itself in Chinese isolation, there is no saying how long this state of things might have endured. But, happily, it was not left to itself. Even earlier than the thirteenth century, the development of Moorish civilization in Spain and the great movement of the Crusades had introduced the leaven which, from that day to this has never ceased to work. At first, through the intermediation of Arabic translations, afterwards by the study of the originals, the western nations of Europe became acquainted with the writings of the ancient philosophers and poets with the whole of the vast literature of antiquity. Whatever there was of high intellectual aspiration or dominant capacity in Italy, France, Germany, and England, spent itself for centuries in taking possession of the rich inheritance left by the dead civilization of Greece and Rome. Marvelously aided by the invention of printing, classical learning spread and flourished. Those who possessed it prided themselves on having attained the highest culture then within the reach of mankind.

**Chapter 2 : Science and Culture by T. H. Huxley ()**

*Science and Culture. by Thomas H. Huxley () 1 Electronic edition by Ian Lancashire From the time that the first suggestion to introduce physical science into ordinary education was timidly whispered, until now, the advocates of scientific education have met with opposition of two kinds.*

He was the second youngest of eight children of George Huxley and Rachel Withers. Like some other British scientists of the nineteenth century such as Alfred Russel Wallace , Huxley was brought up in a literate middle-class family which had fallen on hard times. His father was a mathematics teacher at Ealing School until it closed, [9] putting the family into financial difficulties. As a result, Thomas left school at age 10, after only two years of formal schooling. He became one of the great autodidacts of the nineteenth century. In his teens he taught himself German , eventually becoming fluent and used by Charles Darwin as a translator of scientific material in German. He learned Latin , and enough Greek to read Aristotle in the original. Huxley, aged 21 Later on, as a young adult, he made himself an expert, first on invertebrates , and later on vertebrates , all self-taught. He was skilled in drawing and did many of the illustrations for his publications on marine invertebrates. In his later debates and writing on science and religion his grasp of theology was better than most of his clerical opponents. Huxley, a boy who left school at ten, became one of the most knowledgeable men in Britain. Here Thomas would have seen poverty, crime and rampant disease at its worst. Now 16, Huxley entered Sydenham College behind University College Hospital , a cut-price anatomy school whose founder, Marshall Hall , discovered the reflex arc. All this time Huxley continued his programme of reading, which more than made up for his lack of formal schooling. He was a fine teacher, up-to-date in physiology and also an ophthalmic surgeon. No doubt remembering this, and of course knowing his merit, later in life Huxley organised a pension for his old tutor. At twenty he passed his First M. However, he did not present himself for the final Second M. His apprenticeships and exam results formed a sufficient basis for his application to the Royal Navy. He had references on character and certificates showing the time spent on his apprenticeship and on requirements such as dissection and pharmacy. Sir William Burnett, the Physician General of the Navy, interviewed him and arranged for the College of Surgeons to test his competence by means of a viva voce. The Rattlesnake left England on 3 December and, once they had arrived in the southern hemisphere, Huxley devoted his time to the study of marine invertebrates. Both before and after the voyage Forbes was something of a mentor to Huxley. Huxley united the Hydroid and Sertularian polyps with the Medusae to form a class to which he subsequently gave the name of Hydrozoa. The connection he made was that all the members of the class consisted of two cell layers, enclosing a central cavity or stomach. This is characteristic of the phylum now called the Cnidaria. He compared this feature to the serous and mucous structures of embryos of higher animals. When at last he got a grant from the Royal Society for the printing of plates, Huxley was able to summarise this work in *The Oceanic Hydrozoa*, published by the Ray Society in . In the following year, at the age of twenty-six, he not only received the Royal Society Medal but was also elected to the Council. The Admiralty retained him as a nominal assistant-surgeon, so he might work on the specimens he collected and the observations he made during the voyage of the Rattlesnake. It and the Ascidiaceae are both, as Huxley showed, tunicates , today regarded as a sister group to the vertebrates in the phylum Chordata. He wrote up the voyage in the standard Victorian two volume format. Huxley retired in , after a bout of depressive illness which started in . Finally, in , he died of a heart attack after contracting influenza and pneumonia , and was buried in North London at St Marylebone. No invitations were sent out, but two hundred people turned up for the ceremony; they included Joseph Dalton Hooker , William Henry Flower , Mulford B. Noel Huxley " , died aged 4. Jessie Oriana Huxley " , married architect Fred Waller in . Marian Huxley " , married artist John Collier in . Leonard Huxley " , married Julia Arnold. Rachel Huxley " , married civil engineer Alfred Eckersley in . Henry Huxley " , became a fashionable general practitioner in London. Ethel Huxley " married artist John Collier widower of sister in .

Public duties and awards[ edit ] From onwards, Huxley was to some extent drawn away from scientific research by the claims of public duty. He served on eight Royal Commissions , from to . From to he was a Secretary of the Royal Society and from to he was president. He was

president of the Geological Society from to In , he was president of the British Association at Liverpool and, in the same year was elected a member of the newly constituted London School Board. He was president of the Quekett Microscopical Club from to He was the leading person amongst those who reformed the Royal Society, persuaded government about science, and established scientific education in British schools and universities. The Royal Society , who had elected him as Fellow when he was 25 , awarded him the Royal Medal the next year , a year before Charles Darwin got the same award. He was the youngest biologist to receive such recognition. There were many other elections and appointments to eminent scientific bodies; these and his many academic awards are listed in the Life and Letters. He turned down many other appointments, notably the Linacre chair in zoology at Oxford and the Mastership of University College, Oxford. Despite his many achievements he was given no award by the British state until late in life. In this he did better than Darwin, who got no award of any kind from the state. He had, directly or indirectly, guided the careers and appointments of the next generation, but none were of his stature. The loss of Francis Balfour in , climbing the Alps just after he was appointed to a chair at Cambridge, was a tragedy. Huxley thought he was "the only man who can carry out my work": Clifford were "the greatest losses to science in our time". In the same vein, he tended to push the origin of major groups such as birds and mammals back into the Palaeozoic era, and to claim that no order of plants had ever gone extinct. However, gradually Huxley moved away from this conservative style of thinking as his understanding of palaeontology, and the discipline itself, developed. His work on fossil fish shows his distinctive approach: His interest in these fish brought him close to the origin of tetrapods , one of the most important areas of vertebrate palaeontology. His papers on Archaeopteryx and the origin of birds were of great interest then and still are. On his tour of America Huxley was shown the remarkable series of fossil horses, discovered by O. Funded by his uncle George Peabody , Marsh had made some remarkable discoveries: By looking at their teeth he could see that, as the size grew larger and the toes reduced, the teeth changed from those of a browser to those of a grazer. All such changes could be explained by a general alteration in habitat from forest to grassland. The modern account of the evolution of the horse has many other members, and the overall appearance of the tree of descent is more like a bush than a straight line. The horse series also strongly suggested that the process was gradual, and that the origin of the modern horse lay in North America, not in Eurasia. If so, then something must have happened to horses in North America, since none were there when Europeans arrived. The gibbon left is double size. It was the kind of thing Darwin did with his closest scientific friends, but he must have had some particular intuition about Huxley, who was from all accounts a most impressive person even as a young man. Logically speaking, the prior question was whether evolution had taken place at all. So it can be said that, just as Darwin groomed Huxley, so Owen groomed Wilberforce; and both the proxies fought public battles on behalf of their principals as much as themselves. Though we do not know the exact words of the Oxford debate, we do know what Huxley thought of the review in the Quarterly: Caricature of Huxley by Carlo Pellegrini in Vanity Fair Since Lord Brougham assailed Dr Young , the world has seen no such specimen of the insolence of a shallow pretender to a Master in Science as this remarkable production, in which one of the most exact of observers, most cautious of reasoners, and most candid of expositors, of this or any other age, is held up to scorn as a "flighty" person, who endeavours "to prop up his utterly rotten fabric of guess and speculation," and whose "mode of dealing with nature" is reprobated as "utterly dishonourable to Natural Science. A letter from Huxley to Ernst Haeckel 2 November states: Debate with Wilberforce[ edit ] Main article: The letters of Alfred Newton include one to his brother giving an eye-witness account of the debate, and written less than a month afterwards. In the absence of a verbatim report differing perceptions are difficult to judge fairly; Huxley wrote a detailed account for Darwin, a letter which does not survive; however, a letter to his friend Frederick Daniel Dyster does survive with an account just three months after the event. Another consequence was to alert him to the importance of public debate: A third effect was to serve notice that Darwinian ideas could not be easily dismissed: A fifth consequence was indirect: Many of the liberal clergy at the meeting were quite pleased with the outcome of the debate; they were supporters, perhaps, of the controversial Essays and Reviews. Thus both on the side of science, and on the side of religion, the debate was important, and its outcome significant. This led him directly into a clash with Richard Owen , a man widely disliked for his behaviour whilst also being

admired for his capability. The struggle was to culminate in some severe defeats for Owen. Also in a series of talks to working men was printed lecture by lecture as pamphlets, later bound up as a little green book; the first copies went on sale in December. Although Darwin did not publish his *Descent of Man* until , the general debate on this topic had started years before there was even a precursor debate in the 18th century between Monboddo and Buffon. Darwin had dropped a hint when, in the conclusion to the *Origin*, he wrote: A key event had already occurred in when Richard Owen presented to the Linnean Society his theory that man was marked off from all other mammals by possessing features of the brain peculiar to the genus *Homo*. Having reached this opinion, Owen separated man from all other mammals in a subclass of its own. I cannot swallow that! Huxley with sketch of a gorilla skull c The subject was raised at the BA Oxford meeting, when Huxley flatly contradicted Owen, and promised a later demonstration of the facts. In fact, a number of demonstrations were held in London and the provinces. In at the Cambridge meeting of the B. The debate was widely publicised, and parodied as the Great Hippocampus Question. Owen conceded that there was something that could be called a hippocampus minor in the apes, but stated that it was much less developed and that such a presence did not detract from the overall distinction of simple brain size.

**Chapter 3 : Americans' Perception of Conflict Between Science and Religion**

*Science and Culture, Introductory Note Thomas Henry Huxley () was born at Ealing, near London, and, having studied medicine, went to sea as assistant surgeon in the navy.*

Bailey at Lynton J. Huxley, Diary of H. Rattlesnake Science and Culture Collected Essays III [] Six years ago, as some of my present hearers may remember, I had the privilege of addressing a large assemblage of the inhabitants of this city, who had gathered together to do honour to the memory of their famous townsman, Joseph Priestley; 1 and, if any satisfaction attaches to posthumous glory, we may hope that the manes of the burnt-out philosopher were then finally appeased. Hence I am disposed to think that, if Priestley could be amongst us to-day, the occasion of our meeting would afford him even greater pleasure than the proceedings which celebrated the centenary of his chief discovery. The kindly heart would be moved, the high sense of social duty would be satisfied, by the spectacle of well-earned wealth, neither squandered in tawdry luxury and vainglorious show, nor scattered with the careless charity which blesses neither him that gives nor him that takes, but expended in the execution of a well-considered plan for the aid of present and future generations of those who are willing to help themselves. We shall all be of one mind thus far. In the last century, the combatants were the champions of ancient literature on the one side, and those of modern literature on the other; but, some thirty years 2 ago, the contest became complicated by the appearance of a third army, ranged round the banner of Physical Science. I am not aware that any one has authority to speak in the name of this new host. For it must be admitted to be somewhat of a guerilla force, composed largely of irregulars, each of whom fights pretty much for his own hand. But the impressions of a full private, who has seen a good deal of service in the ranks, respecting the present position of affairs and the conditions of a permanent peace, may not be devoid of interest; and I do not know that I could make a better use of the present opportunity than by laying them before you. From the time that the first suggestion to introduce physical science into ordinary education was [] timidly whispered, until now, the advocates of scientific education have met with opposition of two kinds. On the one hand, they have been pooh-poohed by the men of business who pride themselves on being the representatives of practicality; while, on the other hand, they have been excommunicated by the classical scholars, in their capacity of Levites in charge of the ark of culture and monopolists of liberal education. They were of opinion that science is speculative rubbish; that theory and practice have nothing to do with one another; and that the scientific habit of mind is an impediment, rather than an aid, in the conduct of ordinary affairs. His spiritual wounds, such as are inflicted by logical weapons, may be as deep as a well and as wide as a church door, but beyond shedding a few drops [] of ichor, celestial or otherwise, he is no whit the worse. So, if any of these opponents be left, I will not waste time in vain repetition of the demonstrative evidence of the practical value of science; but knowing that a parable will sometimes penetrate where syllogisms fail to effect an entrance, I will offer a story for their consideration. Once upon a time, a boy, with nothing to depend upon but his own vigorous nature, was thrown into the thick of the struggle for existence in the midst of a great manufacturing population. He seems to have had a hard fight, inasmuch as, by the time he was thirty years of age, his total disposable funds amounted to twenty pounds. Nevertheless, middle life found him giving proof of his comprehension of the practical problems he had been roughly called upon to solve, by a career of remarkable prosperity. Finally, having reached old age with its well-earned surroundings of "honour, troops of friends," the hero of my story bethought himself of those who were making a like start in life, and how he could stretch out a helping hand to them. After long and anxious reflection this successful practical man of business could devise nothing better than to provide them with the means of obtaining "sound, extensive, and practical scientific knowledge. We may take it for granted then, that, in the opinion of those best qualified to judge, the diffusion of thorough scientific education is an absolutely essential condition of industrial progress; and that the College which has been opened to-day will confer an inestimable boon upon those whose livelihood is to be gained by the practise of the arts and manufactures of the district. The only question worth discussion is, whether the conditions, under which the work of the College is to be carried out, are such as to give it the best possible chance of achieving permanent

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I am too well acquainted with the generous catholicity of spirit, the true sympathy with scientific thought, which pervades the writings of our chief apostle of culture to identify him with these opinions; and yet one may cull from one and another of those epistles to the Philistines, which so much delight all who do not answer to that name, sentences which lend them some support. Arnold tells us that the meaning of culture is "to know the best that has been thought and said in the world. That criticism regards "Europe as being, for intellectual and spiritual purposes, one great confederation, bound to a joint action and working to a common result; and whose members have, for their common outfit, a knowledge of Greek, Roman, and Eastern [] antiquity, and of one another. Special, local, and temporary advantages being put out of account, that modern nation will in the intellectual and spiritual sphere make most progress, which most thoroughly carries out this programme. And what is that but saying that we too, all of us, as individuals, the more thoroughly we carry it out, shall make the more progress? The first, that a criticism of life is the essence of culture; the second, that literature contains the materials which suffice for the construction of such a criticism. I think that we must all assent to the first proposition, For culture certainly means something quite different from learning or technical skill, It implies the possession of an ideal, and the habit of critically estimating the value of things by comparison with a theoretic standard. Perfect culture should supply a complete theory of life, based upon a clear knowledge alike of its possibilities and of its limitations. But we may agree to all this, and yet strongly dissent from the assumption that literature alone is competent to supply this knowledge. 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opinions may with equal confidence be sought in history. It is, happily, no new thing that Englishmen should employ their wealth in building and endowing institutions for educational purposes. But, five or six hundred years ago, deeds of foundation expressed or implied conditions as nearly as possible contrary to those which have been thought expedient by Sir Josiah Mason. That is to say, physical science was practically ignored, while a certain literary training was enjoined as a means to the acquirement of knowledge which was essentially theological. At that time, in fact, if any one desired knowledge beyond such as could be obtained by his own observation, or by common conversation, his first necessity was to learn the Latin language, inasmuch as all the higher knowledge of the western world was contained in works written in that language. Hence, Latin grammar, with logic and rhetoric, studied through Latin, were the fundamentals of education. With respect to the substance of the knowledge imparted through this channel, the Jewish and Christian Scriptures, as interpreted and supplemented by the Romish Church, were held to contain a complete and infallibly true body of information. Theological dicta were, to the thinkers of those days, that which the axioms and definitions of Euclid are to the geometers of these. The business of the philosophers of the middle ages was to deduce from the data furnished by the theologians, conclusions in accordance with ecclesiastical decrees. They were allowed the high privilege of showing, by logical process, how and why that which the church said was true, must be true. And if their demonstrations fell short of or exceeded this limit, the church was maternally ready to check their [] aberrations; if need were by the help of the secular arm. Between the two, our ancestors were furnished with a compact and complete criticism of life. They were told how the world began and how it would end; they learned that all material existence was but a base and insignificant blot upon the fair face of the spiritual world, and that nature was, to all intents and purposes, the play-ground of the devil; they learned that the earth is the centre of the visible universe, and that man is the cynosure of things terrestrial; and more especially was it inculcated that the course of nature had no fixed order, but that it could be, and constantly was, altered by the agency of innumerable spiritual beings, good and bad, according as they were moved by the deeds and prayers of men. The sum and substance of the whole doctrine was to produce the conviction that the only thing really worth knowing in this world was how to secure that place in a better which, under certain conditions, the church promised. Our ancestors had a living belief in this theory of life, and acted upon it in their dealings with education, as in all other matters. And, if any born scientific investigator followed his instincts, he might safely reckon upon earning the reputation, and probably upon suffering the fate, of a sorcerer. Had the western world been left to itself in Chinese isolation, there is no saying how long this state of things might have endured. But, happily, it was not left to itself. Even earlier than the thirteenth century, the development of Moorish civilisation in Spain and the great movement of the Crusades had introduced the leaven which, from that day to this, has never ceased to work. At first, through the intermediation of Arabic translations, afterwards by the study of the originals, the western nations of Europe became acquainted with the writings of the ancient philosophers and poets, and, in time, with the whole of the vast literature of antiquity. Whatever there was of high intellectual aspiration or dominant capacity in Italy, France, Germany, and England, spent itself for centuries in taking possession of the rich inheritance left by the dead civilisations of Greece and Rome. Marvellously aided by the invention of printing, [] classical learning spread and flourished. Those who possessed it prided themselves on having attained the highest culture then within the reach of mankind. For, saving Dante on his solitary pinnacle, there was no figure in modern literature at the time of the Renaissance to compare with the men of antiquity; there was no art to compete with their sculpture; there was no physical science but that which Greece had created. The new learning necessarily soon exerted a profound influence upon education. The language of the monks and schoolmen seemed little better than gibberish to scholars fresh from Virgil and Cicero, and the study of Latin was placed upon a new foundation. Moreover, Latin itself ceased to afford the sole key to knowledge. The student who sought the highest thought of antiquity, found only a second-hand reflection of it in Roman literature, and turned his face to the full light of the Greeks. And after a battle, not altogether dissimilar to that which is at present being fought over the teaching of physical science, the study of Greek was recognised as an essential element of all higher education. Thus the Humanists, as they were called, won [] the day; and the great reform which they effected was of incalculable service to mankind. But the Nemesis of all reformers is

finality; and the reformers of education, like those of religion, fell into the profound, however common, error of mistaking the beginning for the end of the work of reformation. The representatives of the Humanists, in the nineteenth century, take their stand upon classical education as the sole avenue to culture, as firmly as if we were still in the age of Renaissance. Yet, surely, the present intellectual relations of the modern and the ancient worlds are profoundly different from those which obtained three centuries ago. Leaving aside the existence of a great and characteristically modern literature, of modern painting, and, especially, of modern music, there is one feature of the present state of the civilised world which separates it more widely from the Renaissance, than the Renaissance was separated from the middle ages. This distinctive character of our own times lies in the vast and constantly increasing part which is played by natural knowledge. Not only is our daily life shaped by it, not only does the prosperity of millions of men depend upon it, but our whole theory of life has long been influenced, consciously or unconsciously, by the general conceptions of the universe, which have been forced upon us by physical science. The notions of the beginning and the end of the world entertained by our forefathers are no longer credible. It is even more certain that nature is the expression of a definite order with which nothing interferes, and that the chief business of mankind is to learn that order and govern themselves accordingly. Moreover this scientific "criticism of life" presents itself to us with different credentials from any other. It appeals not to authority, nor to what anybody may have thought or said, but to nature. It admits that all our interpretations of natural fact are more or less imperfect and symbolic, and bids the learner seek for truth not among words but among things. It warns us that the assertion which outstrips evidence is not only a blunder but a crime. The purely classical education advocated by the representatives of the Humanists in our day, gives no inkling of all this. A man may be a better scholar than Erasmus, and know no more of the chief causes of the present intellectual fermentation than Erasmus did. There is no great force in the *tu quoque* argument, or else the advocates of scientific education might fairly enough retort upon the modern Humanists that they may be learned specialists, but that they possess no such sound foundation for a criticism of life as deserves the name of culture. And, indeed, if we were disposed to be cruel, we might urge that the Humanists have brought this reproach upon themselves, not because they are too full of the spirit of the ancient Greek, but because they lack it. The period of the Renaissance is commonly called that of the "Revival of Letters," as if the influences then brought to bear upon the mind of Western Europe had been wholly exhausted in the field of literature. I think it is very commonly forgotten that the revival of science, effected by the same agency, although less conspicuous, was not less momentous. In fact, the few and scattered students of nature of that day picked up the clue to her secrets exactly as it fell from the hands of the [] Greeks a thousand years before. The foundations of mathematics were so well laid by them, that our children learn their geometry from a book written for the schools of Alexandria two thousand years ago. Modern astronomy is the natural continuation and development of the work of Hipparchus and of Ptolemy; modern physics of that of Democritus and of Archimedes; it was long before modern biological science outgrew the knowledge bequeathed to us by Aristotle, by Theophrastus, and by Galen.

**Chapter 4 : Thomas Henry Huxley's Essay, "Science And Culture."**

*NOTES: 1 This was an address delivered in , at the opening of Mason College, Birmingham, England, now the University of Birmingham.. 2 A few words on Sir Josiah Mason (): He began as a hawker and in began to make pens and "soon became the greatest pen-maker in the world."*

In lieu of an abstract, here is a brief excerpt of the content: *Bulletin of the History of Medicine Victorian Psychology and British Culture*, Oxford University Press, In this lucidly written and erudite book, Rick Rylance reconstructs the turbulent, contested discursive world of nineteenth-century British psychology. He chooses to focus on three decades, , before psychology became firmly rooted in the experimental laboratory, beforeâ€”most traditional histories of psychology would claimâ€”it became a proper science. Another of his aims is to portray a culture in flux, one moving from the comfortable settled world of natural theology and discourse about the "soul," toward a serious engagement with relativism, materialism, and new forms of government. As centers of intellectual ferment shifted from Anglican Oxbridge to the provinces, and as communication with a broadening public became valued, certain hierarchies began to be broken down, while others namely those of race and gender were maintained as strictly as ever. From to , he argues, scientists and literary figures took part in the same debates. In the case of the psychologist George Henry Lewes and the novelist George Eliot, living and working in the same house, the histories of science and literature took place "as close as a hallway apart" p. Rylance aims, and succeeds, at recovering a sense of that closeness; and as a literary critic himself examining scientific ideas, he emulates in his own writing the easy and expected ways in which Victorian literature and science were conversant. The book falls into two parts. The first reconstructs the terms and contexts of debates about the mind-body problem in Victorian Britain; the second examines three important but largely neglected scientific figuresâ€”Alexander Bain, Herbert Spencer, and George Henry Lewesâ€”and their engagement with the radical new ideas of the era. In the first part, Rylance discusses the major problems in psychology what was the connection, if any, between mind and body? Rylance pays special attention to the reception of their ideas by examining reviews of their work in important Victorian periodicals, as well as to the charged political contexts in which they debated issues of evolution and the mind. Rylance clearly sees as his most original contribution the restoration of Lewes, hitherto greatly neglected, to his scientific, political, and cultural contexts. His significance for William James is made clear; and an extended comparison between Lewes and the modern philosopher of mind John Searle underscores the persistence of the issues that concerned the Victorians. But Rylance is careful not to make Lewes out to be more modern than he really was, as a quotation demonstrating his very Victorian racial views p. Rylance is representative of a new school of literary critics attuned to science, and he argues forcefully that the literary canon needs to be broadened to include scientific texts. You are not currently authenticated. View freely available titles:

Chapter 5 : Thomas Henry Huxley - Wikipedia

*Science and Culture: Originally delivered as an address, in , at the opening of Mason College, Birmingham, England, now the University of Birmingham.*

Huxley 1 Electronic edition by Ian Lancashire From the time that the first suggestion to introduce physical science into ordinary education was timidly whispered, until now, the advocates of scientific education have met with opposition of two kinds. On the one hand, they have been pooh-poohed by the men of business who pride themselves on being the representatives of practicality; while, on the other hand, they have been excommunicated by the classical scholars, in their capacity of Levites in charge of the ark of culture and monopolists of liberal education. The practical men believed that the idol whom they worship--rule of thumb--has been the source of the past prosperity, and will suffice for the future welfare of the arts and manufactures. They are of opinion that science is speculative rubbish; that theory and practice have nothing to do with one another; and that the scientific habit of mind is an impediment, rather than an aid, in the conduct of ordinary affairs. I have used the past tense in speaking of the practical men --for although they were very formidable thirty years ago, I am not sure that the pure species has not been extirpated. His spiritual wounds, such as are inflicted by logical weapons, may be as deep as a well and as wide as a church door, but beyond shedding a few drops of ichor, celestial or otherwise, he is no whit the worse. So, if any of these opponents be left, I will not waste time in vain repetition of the demonstrative evidence of the practical value of science; but knowing that a parable will sometimes penetrate where syllogisms fail to effect an entrance, I will offer a story for their consideration. Once upon a time, a boy, with nothing to depend upon but his own vigorous nature, was thrown into the thick of the struggle for existence in the midst of a great manufacturing population. He seems to have had a hard fight, inasmuch as, by the time he was thirty years of age, his total disposable funds amounted to twenty pounds. Nevertheless, middle life found him giving proof of his comprehension of the practical problems he had been roughly called upon to solve, by a career of remarkable prosperity. Finally, having reached old age with its well-earned surroundings of "honor, troops of friends," the hero of my story bethought himself of those who were making a like start in life, and how he could stretch out a helping hand to them. After long and anxious reflection this successful practical man of business could devise nothing better than to provide them with the means of obtaining "sound, extensive, and practical scientific knowledge. I need not point the moral of a tale which, as the solid and spacious fabric of the Scientific College assures us, is no fable, nor can anything which I could say intensify the force of this practical answer to practical objections. We may take it for granted then, that, in the opinion of those best qualified to judge, the diffusion of thorough scientific education is an absolutely essential condition of industrial progress; and that the College which has been opened today will confer an inestimable boon upon those whose livelihood is to be gained by the practice of the arts and manufactures of the district. The only question worth discussion is, whether the conditions, under which the work of the College is to be carried out, are such as to give it the best possible chance of achieving permanent success. Sir Josiah Mason, without doubt most wisely, has left very large freedom of action to the trustees, to whom he proposes ultimately to commit the administration of the College, so that they may be able to adjust its arrangements in accordance with the changing conditions of the future. But, with respect to three points, he has laid most explicit injunctions upon both administrators and teachers. Party politics are forbidden to enter into the minds of either, so far as the work of the College is concerned; theology is as sternly banished from its precincts; and finally, it is especially declared that the College shall make no provision for "mere literary instruction and education. But the third prohibition brings us face to face with those other opponents of scientific education, who are by no means in the moribund condition of the practical man, but alive, alert, and formidable. It is not impossible that we shall hear this express exclusion of "literary instruction and education" from a College which, nevertheless, professes to give a high and efficient education, sharply criticized. Certainly the time was that the Levites of culture would have sounded their trumpets against its walls as against an educational Jericho. How often have we not been told that the study of physical science is incompetent to confer culture; that it touches none of the higher problems of life; and, what

is worse, that the continual devotion to scientific studies tends to generate a narrow and bigoted belief in the applicability of scientific methods to the search after truth of all kinds? How frequently one has reason to observe that no reply to a troublesome argument tells so well as calling its author a "mere scientific specialist. For I hold very strongly by two convictions: The first is, that neither the discipline nor the subject-matter of classical education is of such direct value to the student of physical science as to justify the expenditure of valuable time upon either; and the second is, that for the purpose of attaining real culture, an exclusively scientific education is at least as effectual as an exclusively literary education. I need hardly point out to you that these opinions, especially the latter, are diametrically opposed to those of the great majority of educated Englishmen, influenced as they are by school and university traditions. In their belief, culture is obtainable only by a liberal education; and a liberal education is synonymous, not merely with education and instruction in literature, but in one particular form of literature, namely, that of Greek and Roman antiquity. They hold that the man who has learned Latin and Greek, however little, is educated; while he who is versed in other branches of knowledge, however deeply, is a more or less respectable specialist, not admissible into the cultured caste. The stamp of the educated man, the University degree, is not for him. I am too well acquainted with the general catholicity of spirit, the true sympathy with scientific thought, which pervades the writings of our chief apostle of culture to identify him with these opinions; and yet one may cull from one and another of those epistles to the Philistines, which so much delight all who do not answer to that name, sentences which lend them some support. Arnold tells us that the meaning of culture is "to know the best that has been thought and said in the world. That criticism regards "Europe as being, for intellectual and spiritual purposes, one great confederation, bound to a joint action and working to a common result; and whose members have, for their common outfit, a knowledge of Greek, Roman, and Eastern antiquity, and of one another. Special, local, and temporary advantages being put out of account, that modern nation will in the intellectual and spiritual sphere make most progress, which most thoroughly carries out this program. And what is that but saying that we too, all of us, as individuals, the more thoroughly we carry it out, shall make the more progress? The first, that a criticism of life is the essence of culture; the second, that literature contains the materials which suffice for the construction of such criticism. I think that we must all assent to the first proposition. For culture certainly means something quite different from learning or technical skill. It implies the possession of an ideal, and the habit of critically estimating the value of things by comparison with a theoretic standard. Perfect culture should supply a complete theory of life, based upon a clear knowledge alike of its possibilities and of its limitations. But we may agree to all this, and yet strongly dissent from the assumption that literature alone is competent to supply this knowledge. After having learned all that Greek, Roman, and Eastern antiquity have thought and said, and all that modern literature have to tell us, it is not self-evident that we have laid a sufficiently broad and deep foundation for that criticism of life, which constitutes culture. Indeed, to any one acquainted with the scope of physical science, it is not at all evident. Considering progress only in the "intellectual and spiritual sphere," I find myself wholly unable to admit that either nations or individuals will really advance, if their common outfit draws nothing from the stores of physical science. I should say that an army, without weapons of precision and with no particular base of operations, might more hopefully enter upon a campaign on the Rhine, than a man, devoid of a knowledge of what physical science has done in the last century, upon a criticism of life. When a biologist meets with an anomaly, he instinctively turns to the study of development to clear it up. The rationale of contradictory opinions may with equal confidence be sought in history. It is, happily, no new thing that Englishmen should employ their wealth in building and endowing institutions for educational purposes. But, five or six hundred years ago, deeds of foundation expressed or implied conditions as nearly as possible contrary to those which have been thought expedient by Sir Josiah Mason. That is to say, physical science was practically ignored, while a certain literary training was enjoined as a means to the acquirement of knowledge which was essentially theological. The reason of this singular contradiction between the actions of men alike animated by a strong and disinterested desire to promote the welfare of their fellows, is easily discovered. At that time, in fact, if any one desired knowledge beyond such as could be obtained by his own observation, or by common conversation, his first necessity was to learn the Latin language, inasmuch as all the higher knowledge of the western world was contained in

works written in that language. Hence, Latin grammar, with logic and rhetoric, studied through Latin, were the fundamentals of education. With respect to the substance of the knowledge imparted through this channel, the Jewish and Christian Scriptures, as interpreted and supplemented by the Romish Church, were held to contain a complete and infallibly true body of information. Theological dicta were, to the thinkers of those days, that which the axioms and definitions of Euclid are to the geometers of these. The business of the philosophers of the middle ages was to deduce from the data furnished by the theologians, conclusions in accordance with ecclesiastical decrees. They were allowed the high privilege of showing, by logical process, how and why that which the Church said was true, must be true. And if their demonstrations fell short of or exceeded this limit, the Church was maternally ready to check their aberrations; if need were by the help of the secular arm. Between the two, our ancestors were furnished with a compact and complete criticism of life. They were told how the world began and how it would end; they learned that all material existence was but a base and insignificant blot upon the fair face of the spiritual world, and that nature was, to all intents and purposes, the playground of the devil; they learned that the earth is the center of the visible universe, and that man is the cynosure of things terrestrial, and more especially was it inculcated that the course of nature had no fixed order, but that it could be, and constantly was, altered by the agency of innumerable spiritual beings, good and bad, according as they were moved by the deeds and prayers of men. The sum and substance of the whole doctrine was to produce the conviction that the only thing really worth knowing in this world was how to secure that place in a better which, under certain conditions, the Church promised. Our ancestors had a living belief in this theory of life, and acted upon it in their dealings with education, as in all other matters. Culture meant saintliness--after the fashion of the saints of those days; the education that led to it was, of necessity, theological; and the way to theology lay through Latin. That the study of nature--further than was requisite for the satisfaction of everyday wants--should have any bearing on human life was far from the thoughts of men thus trained. And, if any born scientific investigator followed his instincts, he might safely reckon upon earning the reputation, and probably upon suffering the fate, of a sorcerer. Had the western world been left to itself in Chinese isolation, there is no saying how long this state of things might have endured. But, happily, it was not left to itself. Even earlier than the thirteenth century, the development of Moorish civilization in Spain and the great movement of the Crusades had introduced the leaven which, from that day to this, has never ceased to work. At first, through the intermediation of Arabic translations, afterwards by the study of the originals, the western nations of Europe became acquainted with the writings of the ancient philosophers and poets, and, in time, with the whole of the vast literature of antiquity. Whatever there was of high intellectual aspiration or dominant capacity in Italy, France, Germany, and England, spent itself for centuries in taking possession of the rich inheritance left by the dead civilizations of Greece and Rome. Marvelously aided by the invention of printing, classical learning spread and flourished. Those who possessed it prided themselves on having attained the highest culture then within the reach of mankind. For, saving Dante on his solitary pinnacle, there was no figure in modern literature at the time of the Renaissance to compare with the men of antiquity, there was no art to compete with their sculpture; there was no physical science but that which Greece had created. Above all, there was no other example of perfect intellectual freedom--of the unhesitating acceptance of reason as the sole guide to truth and the supreme arbiter of conduct. The new learning necessarily soon exerted a profound influence upon education. The language of the monks and schoolmen seemed little better than gibberish to scholars fresh from Virgil and Cicero, and the study of Latin was placed upon a new foundation. Moreover, Latin itself ceased to afford the sole key to knowledge. The student who sought the highest thought of antiquity, found only a second-hand reflection of it in Roman literature, and turned his face to the full light of the Greeks. And after a battle, not altogether dissimilar to that which is at present being fought over the teaching of physical science, the study of Greek was recognized as an essential element of all higher education. Then the Humanists, as they were called, won the day; and the great reform which they effected was of incalculable service to mankind. But the Nemesis of all reformers is finality; and the reformers of education, like those of religion, fell into the profound, however common, error of mistaking the beginning for the end of the work of reformation. The representatives of the Humanists, in the nineteenth century, take their stand upon classical education as the sole avenue to culture, as firmly as if we were still in

the age of Renaissance. Yet, surely, the present intellectual relations of the modern and the ancient worlds are profoundly different from those which obtained three centuries ago. Leaving aside the existence of a great and characteristically modern literature, of modern painting, and, especially, of modern music, there is one feature of the present state of the civilized world which separates it more widely from the Renaissance, than the Renaissance was separated from the middle ages. This distinctive character of our own times lies in the vast and constantly increasing part which is played by natural knowledge. Not only is our daily life shaped by it; not only does the prosperity of millions of men depend upon it, but our whole theory of life has long been influenced, consciously or unconsciously, by the general conceptions of the universe, which have been forced upon us by physical science. In fact, the most elementary acquaintance with the results of scientific investigation shows us that they offer a broad and striking contradiction to the opinion so implicitly credited and taught in the middle ages. The notions of the beginning and the end of the world entertained by our forefathers are no longer credible. It is even more certain that nature is the expression of a definite order with which nothing interferes, and that the chief business of mankind is to learn that order and govern themselves accordingly. Moreover this scientific "criticism of life" presents itself to us with different credentials from any other. It appeals not to authority, nor to what anybody may have thought or said, but to nature. It admits that all our interpretations of natural fact are more or less imperfect and symbolic, and bids the learner seek for truth not among words but among things. It warns us that the assertion which outstrips evidence is not only a blunder but a crime. The purely classical education advocated by the representatives of the Humanists in our day, gives no inkling of all this. A man may be a better scholar than Erasmus, and know no more of the chief causes of the present intellectual fermentation than Erasmus did. Scholarly and pious persons, worthy of all respect, favor us with allocations upon the sadness of the antagonism of science to their medieval way of thinking, which betray an ignorance of the first principles of scientific investigation, an incapacity for understanding what a man of science means by veracity, and an unconsciousness of the weight of established scientific truths, which is almost comical. There is no great force in the *tu quoque* argument, or else the advocates of scientific education might fairly enough retort upon the modern Humanists that they may be learned specialists, but that they possess no such sound foundation for a criticism of life as deserves the name of culture. And, indeed, if we were disposed to be cruel, we might urge that the Humanists have brought this reproach upon themselves, not because they are too full of the spirit of the ancient Greek, but because they lack it. The period of the Renaissance is commonly called that of the "Revival of Letters," as if the influences then brought to bear upon the mind of Western Europe had been wholly exhausted in the field of literature. I think it is very commonly forgotten that the revival of science, effected by the same agency, although less conspicuous, was not less momentous.

**Chapter 6 : Internet History Sourcebooks**

*This item: Modernism and Time: The Logic of Abundance in Literature, Science, and Culture, Set up a giveaway There's a problem loading this menu right now.*

Science and Culture, Introductory Note Thomas Henry Huxley was born at Ealing, near London, and, having studied medicine, went to sea as assistant surgeon in the navy. After leaving the Government service, he became Professor of Natural History at the Royal School of Mines, and Fullerian Professor of Physiology at the Royal Institution, and later held many commissions and received many distinctions in the scientific world. His special field was morphology, and in it he produced a large number of monographs and several comprehensive manuals. He was one of the foremost and most effective champions of Darwinism, and no scientist has been more conspicuous in the battle between the doctrine of evolution and the older religious orthodoxy. Outside of this particular issue, he was a vigorous opponent of supernaturalism in all its forms, and a supporter of the agnosticism which demands that nothing shall be believed "with greater assurance than the evidence warrants" - the evidence intended being, of course, of the same kind as that admitted in natural science. Of his attitude toward this last, a clear idea may be gained from the following address on "Science and Culture," a singularly forcible plea for the importance of natural science in general education. In all his writings Huxley commands a style excellently adapted to his purpose: Whatever may be the exact magnitude of his services to pure science, he was a master in the writing of English for the purposes of exposition and controversy, and a powerful intellectual influence on almost all classes in his generation. Science and Culture [Footnote 1: Originally delivered as an address, in , at the opening of Mason College, Birmingham, England, now the University of Birmingham. Hence I am disposed to think that, if Priestley could be amongst us to day, the occasion of our meeting would afford him even greater pleasure than the proceedings which celebrated the centenary of his chief discovery. The kindly heart would moved, the high sense of social duty would be satisfied, by the spectacle of well - earned wealth, neither squandered in tawdry luxury and vainglorious show, nor scattered with the careless charity which blesses neither him that gives nor him that takes, but expended in the execution of a well - considered plan for the aid of present and future generations of those who are willing to help themselves. We shall all be of one mind thus far. In the last century, the combatants were the champions of ancient literature, on the one side, and those of modern literature on the other, but, some thirty years<sup>2</sup> ago, the contest became complicated by the appearance of a third army, ranged round the banner of physical science. The advocacy of the introduction of physical science into general education by George Combe and others commenced a good deal earlier; but the movement had acquired hardly any practical force before the time to which I refer. For it must be admitted to be somewhat of a guerilla force, composed largely of irregulars, each of whom fights pretty much for his own hand. But the impressions of a full private, who has seen a good deal of service in the ranks, respecting the present position of affairs and the conditions of a permanent peace, may not be devoid of interest; and I do not know that I could make a better use of the present opportunity than by laying them before you. From the time that the first suggestion to introduce physical science into ordinary education was timidly whispered, until now, the advocates of scientific education have met with opposition of two kinds. On the one hand, they have been poohpoohed by the men of business who pride themselves on being the representatives of practicality; while, on the other hand, they have been excommunicated by the classical scholars, in their capacity of Levites in charge of the ark of culture and monopolists of liberal education. The practical men believed that the idol whom they worship - rule of thumb - has been the source of the past prosperity, and will suffice for the future welfare of the arts and manufactures. They were of opinion that science is speculative rubbish; that theory and practice have nothing to do with one another; and that the scientific habit of mind is an impediment, rather than an aid, in the conduct of ordinary affairs. I have used the past tense in speaking of the practical men - for although they were very formidable thirty years ago, I am not sure that the pure species has not been extirpated. His spiritual wounds, such as are inflicted by logical weapons, may be as deep as a well and as wide as a church door, but beyond shedding a few drops of ichor, celestial or otherwise, he is no whit the worse. So, if any of these opponents be left, I will

not waste time in vain repetition of the demonstrative evidence of the practical value of science; but knowing that a parable will sometimes penetrate where syllogisms fail to effect an entrance, I will offer a story for their consideration. Once upon a time, a boy, with nothing to depend upon but his own vigorous nature, was thrown into the thick of the struggle for existence in the midst of a great manufacturing population. He seems to have had a hard fight, inasmuch as, by the time he was thirty years of age, his total disposable funds amounted to twenty pounds. Nevertheless, middle life found him giving proof of his comprehension of the practical problems he had been roughly called upon to solve, by a career of remarkable prosperity. Finally, having reached old age with its well - earned surroundings of "honor, troops of friends," the hero of my story bethought himself of those who were making a like start in life, and how he could stretch out a helping hand to them. After long and anxious reflection this successful practical man of business could devise nothing better than to provide them with the means of obtaining "sound, extensive, and practical scientific knowledge. I need not point the moral of a tale which, as the solid and spacious fabric of the Scientific College assures us, is no fable, nor can anything which I could say intensify the force of this practical answer to practical objections. We may take it for granted then, that, in the opinion of those best qualified to judge, the diffusion of thorough scientific education is an absolutely essential condition of industrial progress; and that the college which has been opened to - day will confer an inestimable boon upon those whose livelihood is to be gained by the practice of the arts and manufactures of the district. The only question worth discussion is, whether the conditions, under which the work of the college is to be carried out, are such as to give it the best possible chance of achieving permanent success. Sir Josiah Mason, without doubt most wisely, has left very large freedom of action to the trustees, to whom he proposes ultimately to commit the administration of the college, so that they may be able to adjust its arrangements in accordance with the changing conditions of the future. But, with respect to three points, he has laid most explicit injunctions upon both administrators and teachers. Party politics are forbidden to enter into the minds of either, so far as the work of the college is concerned; theology is as sternly banished from its precincts; and finally, it is especially declared that the college shall make no provision for "mere literary instruction and education. But the third prohibition brings us face to face with those other opponents of scientific education, who are by no means in the moribund condition of the practical man, but alive, alert, and formidable. It is not impossible that we shall hear this express exclusion of "literary instruction and education" from a college which, nevertheless, professes to give a high and efficient education, sharply criticised. Certainly the time was that the Levites of culture would have sounded their trumpets against its walls as against an educational Jericho. How often have we not been told that the study of physical science is incompetent to confer culture; that it touches none of the higher problems of life; and, what is worse, that the continual devotion to scientific studies tends to generate a narrow and bigoted belief in the applicability of scientific methods to the search after truth of all kinds. How frequently one has reason to observe that no reply to a troublesome argument tells so well as calling its author a "mere scientific specialist. For I hold very strongly by two convictions. The first is, that neither the discipline nor the subject - matter of classical education is of such direct value to the student of physical science as to justify the expenditure of valuable time upon either; and the second is, that for the purpose of attaining real culture, an exclusively scientific education is at least as effectual as an exclusively literary education. I need hardly point out to you that these opinions, especially the latter, are diametrically opposed to those of the great majority of educated Englishmen, influenced as they are by school and university traditions. In their belief, culture is obtainable only by a liberal education; and a liberal education is synonymous, not merely with education and instruction in literature, but in one particular form of literature, namely, that of Greek and Roman antiquity. They hold that the man who has learned Latin and Greek, however little, is educated; while he who is versed in other branches of knowledge, however deeply, is a more or less respectable specialist, not admissible into cultured caste. The stamp of the educated man, the university degree, is not for him. I am too well acquainted with the generous catholicity of spirit, the true sympathy with scientific thought, which pervades the writings of our chief apostle of culture to identify him with these opinions; and yet one may cull from one and another of those epistles to the Philistines, which so much delight all who do not answer to that name, sentences which lend them some support. Arnold tells us that the meaning of culture is "to know the best that has been thought

and said in the world. That criticism regards "Europe as being, for intellectual and spiritual purposes, one great confederation, bound to a joint action and working to a common result; and whose members have, for their common outfit, a knowledge of Greek, Roman, and Eastern antiquity, and of one another. Special, local, and temporary advantages being put out of account, that modern nation will in the intellectual and spiritual sphere make most progress, which most thoroughly carries out this programme. And what is that but saying that we too, all of us, as individuals, the more thoroughly we carry it out, shall make the more progress? The first, that a criticism of life is the essence of culture; the second, that literature contains the materials which suffice for the construction of such a criticism. I think that we must all assent to the first proposition. For culture certainly means something quite different from learning or technical skill. It implies the possession of an ideal, and the habit of critically estimating the value of things by comparison with a theoretic standard. Perfect culture should apply a complete theory of life, based upon a clear knowledge alike of its possibilities and of its limitations. But we may agree to all this, and yet strongly dissent from the assumption that literature alone is competent to supply this knowledge. After having learnt all that Greek, Roman, and Eastern antiquity have thought and said, and all that modern literatures have to tell us, it is not self evident that we have laid a sufficiently broad and deep foundation for the criticism of life which constitutes culture. Indeed, to any one acquainted with the scope of physical science, it is not at all evident. Considering progress only in the "intellectual and spiritual sphere," I find myself wholly unable to admit that either nations or individuals will really advance, if their common outfit draws nothing from the stores of physical science. I should say that an army, without weapons of precision, and with no particular base of operations, might more hopefully enter upon a campaign on the Rhine, than a man, devoid of a knowledge of what physical science has done in the last century, upon a criticism of life. When a biologist meets with an anomaly, he instinctively turns to the study of development to clear it up. The rationale of contradictory opinions may with equal confidence be sought in history. It is, happily, no new thing that Englishmen should employ their wealth in building and endowing institutions for educational purposes. But, five or six hundred years ago, deeds of foundation expressed or implied conditions as nearly as possible contrary to those which have been thought expedient by Sir Josiah Mason. That is to say, physical science was practically ignored, while a certain literary training was enjoined as a means to the acquirement of knowledge which was essentially theological. The reason of this singular contradiction between the actions of men alike animated by a strong and disinterested desire to promote the welfare of their fellows, is easily discovered. At that time, in fact, if any one desired knowledge beyond such as could be obtained by his own observation, or by common conversation, his first necessity was to learn the Latin language, inasmuch as all the higher knowledge of the western world was contained in works written in that language. Hence, Latin grammar, with logic and rhetoric, studied through Latin, were the fundamentals of education. With respect to the substance of the knowledge imparted through this channel, the Jewish and Christian Scriptures, as interpreted and supplemented by the Romish Church, were held to contain a complete and infallibly true body of information. Theological dicta were, to the thinkers of those days, that which the axioms and definitions of Euclid are to the geometers of these. The business of the philosophers of the Middle Ages was to deduce from the data furnished by the theologians, conclusions in accordance with ecclesiastical decrees. They were allowed the high privilege of showing, by logical process, how and why that which the Church said was true, must be true. And if their demonstrations fell short of or exceeded this limit, the Church was maternally ready to check their aberrations, if need be, by the help of the secular arm. Between the two, our ancestors were furnished with a compact and complete criticism of life. They were told how the world began, and how it would end; they learned that all material existence was but a base and insignificant blot upon the fair face of the spiritual world, and that nature was, to all intents and purposes, the playground of the devil; they learned that the earth is the centre of the visible universe, and that man is the cynosure of things terrestrial; and more especially is it inculcated that the course of nature had no fixed order, but that it could be, and constantly was, altered by the agency of innumerable spiritual beings, good and bad, according as they were moved by the deeds and prayers of men. The sum and substance of the whole doctrine was to produce the conviction that the only thing really worth knowing in this world was how to secure that place in a better, which, under certain conditions, the Church promised. Our ancestors had a living belief in

this theory of life, and acted upon it in their dealings with education, as in all other matters. Culture meant saintlines - after the fashion of the saints of those days; the education that led to it was, of necessity, theological; and the way to theology lay through Latin. That the study of nature - further than was requisite for the satisfaction of everyday wants - should have any bearing on human life was far from the thoughts of men thus trained. And, if any born scientific investigator followed his instincts, he might safely reckon upon earning the reputation, and probably upon suffering the fate, of a sorcerer. Had the western world been left to itself in Chinese isolation, there is no saying how long this state of things might have endured. But, happily, it was not left to itself. Even earlier than the thirteenth century, the development of Moorish civilization in Spain and the great movement of the Crusades had introduced the leaven which, from that day to this, has never ceased to work. At first, through the intermediation of Arabic translations, afterwards by the study of the originals, the western nations of Europe became acquainted with the writings of the ancient philosophers and poets, and, in time, with the whole of the vast literature of antiquity. Whatever there was of high intellectual aspiration or dominant capacity in Italy, France, Germany, and England, spent itself for centuries in taking possession of the rich inheritance left by the dead civilization of Greece and Rome. Marvelously aided by the invention of printing, classical learning spread and flourished. Those who possessed it prided themselves on having attained the highest culture then within the reach of mankind. For, saving Dante on his solitary pinnacle, there was no figure in modern literature at the time of the Renaissance to compare with the men of antiquity; there was no art to compete with their sculpture; there was no physical science but that which Greece had created. Above all, there was no other example of perfect intellectual freedom - of the unhesitating acceptance of reason as the sole guide to truth and the supreme arbiter of conduct. The new learning necessarily soon exerted a profound influence upon education. The language of the monks and schoolmen seemed little better than gibberish to scholars fresh from Vergil and Cicero, and the study of Latin was placed upon a new foundation. Moreover, Latin itself ceased to afford the sole key to knowledge. The student who sought the highest thought of antiquity found only a second - hand reflection of it in Roman literature, and turned his face to the full light of the Greeks. And after a battle, not altogether dissimilar to that which is at present being fought over the teaching of physical science, the study of Greek was recognized as an essential element of all higher education. Thus the humanists, as they were called, won the day; and the great reform which they effected was of incalculable service to mankind. But the Nemesis of all reformers is finality; and the reformers of education, like those of religion, fell into the profound, however common, error of mistaking the beginning for the end of the work of reformation. The representatives of the humanists in the nineteenth century take their stand upon classical education as the sole avenue to culture, as firmly as if we were still in the age of Renaissance. Yet, surely, the present intellectual relations of the modern and the ancient worlds are profoundly different from those which obtained three centuries ago.

**Chapter 7 : Chicago Text Lab » The Science of Modern US Culture**

*literature, science, and culture, example text this is a major aspect of the failure of the modern project (which was, in principle, valid for mankind as a whole). modernism and time: the logic of abundance in, modernism and time.*

Science and technology[ edit ] Technology[ edit ] Development and commercial production of electric lighting was underway. Based at New York City , it was the pioneer company of the electrical power industry. Copper electrical wires would then connect the station with other buildings, allowing for electric power distribution. It was located at Pearl Street in Manhattan on a site measuring 50 by feet, [4] just south of Fulton Street. It began with one direct current generator , and it started generating electricity on September 4, , serving an initial load of lamps at 85 customers. By , Pearl Street Station was serving customers with 10, lamps. The electric arc lights went into regular service on December 20, The new Brooklyn Bridge of had seventy arc lamps installed in it. By , there was a reported number of 1, arc lights installed in Manhattan. Stefan Drzewiecki of Podolia , Russian Empire finishes his submarine-building project which had begun in Altogether, 50 units were delivered to the Ministry of War. They were reportedly deployed as part of the defense of Kronstadt and Sevastopol. In , the submarines were transferred to the Imperial Russian Navy. They were soon declared "ineffective" and discarded. By , Drzewiecki was designing submarines for the French Third Republic. During extensive trials, Holland made numerous dives and test-fired the gun using dummy projectiles. It reportedly had a range of 10 to 25 miles, powered by a lead acid battery. A significant innovation of the vehicle was its use of electric lights , here playing the role of headlamps. By use of variable engine strokes from a complex crankshaft , Atkinson was able to increase the efficiency of his engine, at the cost of some power, over traditional Otto-cycle engines. James Wimshurst of Poplar , London , England was born. John Hopkinson of Manchester , England patents the three-phase electric power system in In Hopkinson showed mathematically that it was possible to connect two alternating current dynamos in parallel a problem that had long bedeviled electrical engineers. Charles Fritts , an American inventor, creates the first working solar cell. Denounced as a fraud in the US for "generating power without consuming matter, thus violating the laws of physics ". Tuck , an American inventor, works in his own submarine designs. His model was created in Delameter Iron Works. It was feet long, "all-electric and had vertical and horizontal propellers clutched to the same shaft, with a feet breathing pipe and an airlock for a diver. It used "a caustic soda patent boiler to power a HP Westinghouse steam engine". She managed a number of short trips within the New York Harbor area. Tuck did not benefit from his achievement. His family feared that the inventor was squandering his fortune on the Peacemaker. They had him committed to an insane asylum by the end of the decade. In , using a glider designed and built in , Montgomery made the "first heavier-than-air human-carrying aircraft to achieve controlled piloted flight" in the Western Hemisphere. This glider had a curved parabolic wing surface. He reportedly made a glide of "considerable length" from Otay Mesa, San Diego, California , his first successful flight and arguably the first successful one in the United States. In , Montgomery tested a second monoplane glider with flat wings. The innovation in design was " hinged surfaces at the rear of the wings to maintain lateral balance ". These were early forms of Aileron. After experimentation with a water tank and smoke chamber to understand the nature of flow over surfaces, in , Montgomery designed a third glider with fully rotating wings as pitcherons. He then turned to theoretic research towards the development of a manuscript "Soaring Flight" in Krebs piloted the first fully controlled free-flight with the La France. It was the first full round trip flight [20] with a landing on the starting point. On its seven flights in and [21] the La France dirigible returned five times to its starting point. It was feet This motor was later replaced with one that produced 8. It was the basis of his patent method of translating visual images to electronic impulses, transmit said impulses to another device and successfully reassemble the impulses to visual images. Nipkow used a selenium photoelectric cell. Alexander Mozhaysky of Kotka , Grand Duchy of Finland , Russian Empire makes the second known "powered, assisted take off of a heavier-than-air craft carrying an operator". His steam-powered monoplane took off at Krasnoye Selo , near Saint Petersburg , making a hop and "covering between 65 and feet". The monoplane had a failed landing , with one of its wings destroyed and serious

damages. It was never rebuilt. The Grand Soviet Encyclopedia called this "the first true flight of a heavier-than-air machine in history". In their joint patent application for the "Z. In the closed-core type, the primary and secondary windings were wound around a closed iron ring; in the shell type, the windings were passed through the iron core. In both designs, the magnetic flux linking the primary and secondary windings traveled almost entirely within the iron core, with no intentional path through air. When employed in electric distribution systems, this revolutionary design concept would finally make it technically and economically feasible to provide electric power for lighting in homes, businesses and public spaces. The inventors also popularized the word "transformer" to describe a device for altering the EMF of an electric current, [27] [30] although the term had already been in use by To save money, the hull was largely of wood, framed with iron hoops, and again, a Brayton-cycle engine provided motive power. The submarine was ready for launching in September. Although the submarine was repaired and eventually carried out several trial runs in lower New York Harbor, by the end of the Nautilus Submarine Boat Company was no more, and the salvageable remnants of the Zalinski Boat were sold to reimburse the disappointed investors. Galileo Ferraris of Livorno Piemonte, Kingdom of Italy reaches the concept of a rotating magnetic field. He applied it to a new motor. The motor, the direction of which could be reversed by reversing its polarity, proved the solution to the last remaining problem in alternating-current motors. The principle made possible the development of the asynchronous, self-starting electric motor that is still used today. Believing that the scientific and intellectual values of new developments far outstripped material values, Ferraris deliberately did not patent his invention; on the contrary, he demonstrated it freely in his own laboratory to all comers. By then, Nikola Tesla had independently reached the same concept and was seeking a patent. Introducing a method of carbon arc welding, they also became the "inventors of modern welding apparatus". The first successful tests on public roads were carried out in the early summer of The next year Benz created the Motorwagen Model 2 which had several modifications, and in , the definitive Model 3 with wooden wheels was introduced, showing at the Paris Expo the same year. He entrusted engineer Stanley with the building of a device for commercial use. This design was first used commercially in Prewound copper coils could then be slid into place, and straight iron plates laid in to create a closed magnetic circuit. Westinghouse applied for a patent for the new design in December; it was granted in July She could not stay at a stable depth, set by the operator. The improved Goubet II was introduced in This version could transport a 2-man crew and had "an attractive interior". More stable than her predecessor, though still unable to stay at a set depth. The first was the Nordenfelt I, a 56 tonne, It was manufactured by Bolinders in Stockholm in " Like the Resurgam, it operated on the surface using a HP steam engine with a maximum speed of 9 kn, then it shut down its engine to dive. Following the acceptance tests, she was never used again by the Hellenic Navy and was scrapped in Once underwater, sudden changes in speed or direction triggered " in the words of a U. Navy intelligence report "dangerous and eccentric movements. However, good public relations overcame bad design: Carl Gassner of Mainz, German Empire receives a patent for a zinc-carbon battery, among the earliest examples of dry cell batteries. Consumer dry cells would first appear in the s. Within the year, Hellesen and V. Ludvigsen founded a factory in Frederiksberg, producing their batteries. The basic invention involves passing an electric current through a bath of alumina dissolved in cryolite, which results in a puddle of aluminum forming in the bottom of the retort. His research partner was Julia Brainerd Hall, an older sister. She had studied chemistry at Oberlin College, helped with the experiments, took laboratory notes and gave business advice to Charles. Herbert Akroyd Stuart of Halifax Yorkshire, England receives his first patent on a prototype of the hot bulb engine. His research culminated in an for a compression ignition engine. It had a comparatively low compression ratio, so that the temperature of the air compressed in the combustion chamber at the end of the compression stroke was not high enough to initiate combustion. Combustion instead took place in a separated combustion chamber, the "vaporizer" also called the "hot bulb" mounted on the cylinder head, into which fuel was sprayed. Self-ignition occurred from contact between the fuel-air mixture and the hot walls of the vaporizer. The electrical supply industry needed instruments capable of measuring high voltages. It could measure both direct current DC and alternating current AC flows.

**Chapter 8 : Project MUSE - Victorian Psychology and British Culture, (review)**

*HUXLEY'S address on "Science and Culture" 1 was delivered in , at the opening of Mason Science College in Birmingham, England. Like many academic addresses, it not only celebrates a local event, but also deals with questions of the day, chosen to suit the occasion.*

**Chapter 9 : The Culture of Time and Space, by Stephen Kern**

*Get this from a library! Modernism and time: the logic of abundance in literature, science, and culture, [Ronald Schleifer].*