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READINGS FROM HUXLEY

EDITED WITH INTRODUCTION BY

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TO MY COLLEAGUES

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INTRODUCTION

THE pursuit of truth was the keynote of Huxley's life and work. Not that he was always right; as Sam Slick said, "there is a great deal of human nature in all mankind." Like the rest of us, though we must admit less often than the rest of us, he sometimes mistook error for truth; he held at various times, perhaps even at the same time, ideas inconsistent with one another. He was right more often than we, however, and he was able to add to the world's knowledge, to the sum of truth, not only because he had early learned from Carlyle the hatred of cant, humbugs, and shams, but also because his conception of truth provided a method of discovering and rejecting error. Huxley never regarded truth as final, but always as progressive. Like the pragmatist, he held it impossible to establish fixed and eternal truth by discovering and reasoning from the so-called laws of the universe; he rather sought by observation, deduction, and verification — i.e., by the scientific method — to generalise the facts of existence as we find them, and thus to arrive at rational certainty. In the scientific field, which was particularly his own, and which lends itself to a strict method of truth seeking and finding more readily (but no more justly) than do abstract subjects, this method was highly successful and led to the establishment of important truth. In the field of ethics, however, Huxley was less successful. His most valuable work there was destructive — in exposing by his method of verification the fallacy of de-

pending too much upon absolute authority. When he undertook, however, to build up his own system of ethics, he had not the same command of evidence that he had in science, and he sometimes accepted assumptions which a rigid application of his method would have led him to reject.

To one who insists upon an immutable, absolute truth, Huxley may well seem not to arrive at truth at all; indeed he admitted that "it may fairly be doubted whether any generalisation, or hypothesis, based upon physical data is absolutely true, in the sense that a mathematical proposition is so." And he bases "rational certainty" upon two grounds: "the one that the evidence in favour of a given statement is as good as it can be" — when "the statement is to be taken as true"; the other, "that such evidence is plainly insufficient," — when it is untrue. But in each case it is true or false only "until something arises to modify the verdict, which, however properly reached, may always be more or less wrong, the best information being never complete, and the best reasoning being liable to fallacy." This pragmatic kind of truth is, however, more rather than less dependable than so-called absolute truth because, as Huxley points out, since the errors of such scientific generalisation "can become apparent only outside the limits of practicable observation, it may be just as usefully adopted . . . as if it were absolutely true." The justification of employing such postulates "as axioms of physical philosophy, lies in the circumstance that expectations logically based upon them are verified, or at any rate, not contradicted, whenever they can be tested by experience." Truth which rests upon authority or *a priori* assumption, on the other hand, defies both changing circumstances and verification of its *dicta*. A recent critic of Huxley, Mr. Paul Elmer More, condemns

Huxley's use of uncontradicted as well as verified hypotheses because, he says, the way to truth does not lie through error. That assertion seems to me less well founded than Bacon's saying, reiterated by Huxley, that "truth more easily comes out of error than out of confusion." This is certainly the case when one is armed with Huxley's habit of testing every hypothesis by bringing in all the evidence available — "is the evidence adequate to bear out the theory, or is it not?" — and his determination to "rest in no lie, and to rest in no verbal delusions."

The perception that truth is not final did not, as I said at starting, prevent Huxley from regarding it as the immediate jewel of his soul. Perhaps indeed truth is to be the more jealously cherished when every man bears the responsibility of discovering and preserving it. At any rate Huxley conceived highly of his duty to truth, watched anxiously his worthiness to serve it, and was resolved greatly to find quarrel in a straw when truth was at the stake. He wrote to his sister in 1850:

"I will leave my mark somewhere, and it shall be clear and distinct [T.H.H., his mark.] and free from the abominable blur of cant, humbug, and self-seeking which surrounds everything in this present world — that is to say, supposing that I am not already unconsciously tainted myself, a result of which I have a morbid dread."

After forty years his adherence to truth was but strengthened by the battles he had waged in her name against adversaries superior in numbers, entrenched in ages old habits of thought, and fortified by ecclesiastical authority.

"Belief in majorities is not rooted in my breast, and if all the world were against me the fact might warn me to revise and criticise my opinions, but would not in itself supply a ghost

of a reason for forsaking them. For myself I say deliberately, it is better to have a millstone tied around the neck and be thrown into the sea than to share the enterprises of those to whom the world has turned, and will turn, because they minister to its weaknesses and cover up the awful realities which it shudders to look at."

I

So effectively did Huxley serve truth in the realm of science that it is hard now to realise that fifty years ago it was necessary to contend vigorously for the introduction of the experimental method in the study of the natural sciences as well as in physics and chemistry, that there was a fury of opposition to the theory of evolution, or that the very foundations of religion were felt to rock when science asserted that the Biblical account of the creation and of the flood is chiefly legend, that there is insufficient real evidence of the "existence and activity of a demonic world," and that the strict historical accuracy of the Pentateuch and the Gospels may be questioned.

Huxley's contributions to purely scientific knowledge I am incompetent to discuss; I accept the judgment of others that they are of the highest value. But I believe that, valuable as his scientific studies are, they do not claim the attention of students of literature as his less technical essays do. One gains, however, a heightened opinion of the powers of man when he looks over the eleven pages of titles of scientific memoirs in Leonard Huxley's *Life and Letters* of his father. The first is "On a Hitherto Undescribed Structure in the Human Hair Sheath," 1845, the last, "The Gentians: Notes and Queries," 1888; the subjects between range over

observations on plants and animals of the land and sea, little known, familiar, and fossil, on the structure and motion of glaciers, on comparative anatomy and osteology, on the relation of man to the lower animals, on ethnology, paleontology, and on other subjects whose names mean nothing to the lay reader. These scientific studies Huxley did not see fit to include in the nine volumes of his collected essays, 1893 and 1894, and only three of these volumes are chiefly scientific, *Darwiniana*, *Man's Place in Nature*, and *Discourses, Biological and Geological*. These three include some of his most brilliant writing and are admirable models of lucid and fascinating exposition of difficult subjects. They exhibit too his great gift of showing the significance of science in human life, of seeing science not as a realm apart but as a means of understanding the world in which we live and man's relation to it. And so science taught Huxley not only that the chalky cliffs of England and the coral reefs of the south seas have been built up during ages from the skeletons of tiny animals, and that all life, both vegetable and animal, is connected by a common physical basis, but that even man, "in substance and in structure, one with the brutes," takes his place in "Nature's great progression." However I have omitted selections from these essays from this little book because they have lost the glamour of novelty and they have not the lively challenge of the essays on subjects still in dispute.

But if we cannot dwell on the results of Huxley's labours in the realm of pure science, we can admire the method by which they were attained, the "only method by which intellectual truth can be reached," as Huxley said, which "simply uses with scrupulous exactness the methods which we all, habitually and at every moment, use carelessly." And we can perceive ample justifica-

tion, so far as science is concerned, for his belief that "the only source of real knowledge lies in the application of scientific methods of inquiry to the ascertainment of the facts of existence; that the ascertainable is infinitely greater than the ascertained." So when Darwin startled the world with his theory of evolution, Huxley was ready first to examine it, to point out its weak points, and then to become its ardent champion and "Darwin's bull-dog." "The only rational course for those who had no other object than the attainment of truth," he wrote in a chapter contributed to the *Life of Darwin*, "was to accept 'Darwinism' as a working hypothesis and see what could be made of it. Either it would prove its capacity to elucidate the facts of organic life, or it would break down under the strain."

Once convinced of the essential truth of the theory of evolution, Huxley did valuable service in extending the application of that truth to human life. For him the theory destroyed the mechanistic conception of the universe and showed that a world which had grown from a nebulous mass and produced forms of life and of intelligence is a world in which further progress is possible and in which man may have a share in shaping his own destiny and that of his fellows. Instead of regarding man's place in the scheme of evolution as degrading, as many of his contemporaries did, he saw in his rise from "lowly stock," "the best evidence of the splendour of his capacities," and "in his long progress through the Past, a reasonable ground of faith in his attainment of a noble Future."

One of the great moments in Huxley's career was his reply to Wilberforce who, as the champion of orthodoxy, attacked the theory of evolution at a meeting of the British Association at Oxford in 1860. The Bishop is said to have spoken "for full half an hour with inimitable

spirit, emptiness, and unfairness" to a large and distinguished audience. He concluded by turning to Huxley, who sat on the platform, and asking "with a smiling insolence" whether it was "through his grandfather or his grandmother that he claimed his descent from a monkey?" At this stooping to personality Huxley is said to have struck his hand upon his knee, exclaiming to his neighbor, "The Lord hath delivered him into mine hands." Huxley's reply created a tremendous sensation, so tremendous that no one could remember exactly what he said. What was clear to all was that he had delivered a stinging and characteristic rebuke to that smug orthodoxy which repudiated science when it seemed to threaten its authority. The most accurate account of the reply, according to Leonard Huxley, is that of J. R. Green.

"I asserted — and I repeat — that a man has no reason to be ashamed of having an ape for his grandfather. If there were an ancestor whom I should feel shame in recalling it would rather be a man — a man of restless and versatile intellect — who, not content with an equivocal success in his own sphere of activity, plunges into scientific questions with which he has no real acquaintance, only to obscure them by an aimless rhetoric, and distract the attention of his hearers from the real point at issue by eloquent digressions and skilled appeals to religious prejudice."

II

Next to his work as a scientist Huxley is perhaps best known for his work in education, particularly in his own field of scientific education. Like Matthew Arnold, who was even more actively engaged in educational reform, he endeavoured, in one of the darkest ages for education in England, to make accessible to all a substantial and

liberal education and to revise the curricula and methods of teaching in schools of all grades. It is often supposed, from Arnold's mentioning Huxley in *Literature and Science*, that the two were at odds in their educational programmes. As a matter of fact it was Herbert Spencer who urged the extreme demands of science which Arnold rejected, while Arnold and Huxley probably agreed in more points than they differed in. As a man of letters Arnold had great faith in the humanities and wished to reform and extend the teaching of literature and the classics, to the end that men might gain "soberness, righteousness, and wisdom." As a scientist Huxley sought to demonstrate the educational value of scientific study and wished to add it to the older subjects, that men might be freed from the thralldom of error. But Huxley was far from thinking that science should constitute the whole, or even the greater part, of a general education. He repeatedly insisted that it should but be added to literature, history, ethics, philosophy, music, and drawing.

Huxley's idea of the purpose of education is very practical, yet, well-considered, not without elevation; it is to learn the rules of the game of life.

"In other words, education is the instruction of the intellect in the laws of Nature, under which name I include not merely things and their forces, but men and their ways; and the fashioning of the affections and of the will into an earnest and loving desire to move in harmony with those laws."

To this end he deemed it necessary to make the education of specialists — of doctors and scientists — more literary and to make general education more scientific. In exceptional cases, if he could feel sure that the would-be scientist had "the physical and mental energy to make a mark in science," he would "drive him straight at

science, taking care that he got a literary training through English, French, and German. An average capacity, on the other hand," he added, "may be immensely helped by university means of flotation." To insure a wide diffusion of scientific education he maintained that instruction in the elements of physical science should commence in the elementary schools, but it should not be "teaching astronomy and the use of the globes, and the rest of the abominable trash — but a little instruction of the child in what is the nature of common things about him; what their properties are, and in what relation this actual body of man stands to the universe outside of it."

The importance of the subject of universal education greatly impressed Huxley. "A great deal is said of British interests just now," he said in 1877, "but, depend upon it, that no Eastern difficulty needs our intervention as a nation so seriously, as the putting down both the Bashi-Bazouks of ignorance and the Cossacks of sectarianism at home. What has already been achieved in these directions is a great thing. . . . An education better in its processes, better in its substance, than that which was accessible to the great majority of well-to-do Britons a quarter of a century ago, is now obtainable by every child in the land." But he was far from satisfied with the provision of respectable elementary education. He wished also such continuation schools — good public secondary schools, popular universities, and technical schools — as would constitute "an educational ladder from the gutter to the university, whereby children of exceptional ability might reach the place for which nature had fitted them." He was most eager, and held it one of the best arguments for the state support of education, to provide means for discovering, developing, and utilizing the capacities of specially gifted

men. "The most important object of all educational schemes," he said, "is to catch these exceptional people, and turn them to account for the good of society . . . to keep these glorious sports of Nature from being either corrupted by luxury or starved by poverty, and to put them into the position in which they can do the work for which they are especially fitted."

III

Huxley's efforts to put into effect his educational schemes kindled an interest in political theory, and his theories are the logical result of his habit of subjecting *a priori* reasoning to the process of verification by facts. In 1871 when, as a member of the School Board he wished to demonstrate the wisdom and legality of state support of education, he wrote an address, *Administrative Nihilism*, in which he pointed out the danger to the state of the doctrine of *laissez-faire* in education, and demonstrated the right and duty of the state to provide means of education. His main argument is that it is the duty of the state not simply to punish wrongdoing, but actively to promote the welfare of its citizens.

His other political essays were written nearly twenty years later. They are directed mainly against the "superficially plausible doctrines" of Rousseau and similar political speculators. Their doctrines were being revived by Henry George and other millenarian socialists and seemed to Huxley to threaten the peace if not the safety of society, and he felt bound to expose them. "I thought," he said, "it was my duty to see whether some thirty years' training in the art of making difficult questions intelligible to audiences without much learning, but with that abundance of keen practical sense

which characterises English workmen of the better class, would enable me to do something towards the counteraction of the fallacious guidance which is offered to them." And so he shows that to base any political theory on the supposed substitution of a voluntary social contract for an hypothetical state of nature, whether for the purpose of guaranteeing the freedom of the individual or of maintaining the general welfare by the complete surrender of individual rights to the sovereign state, is to create a false dilemma. Government need not choose between Anarchy and Regimentation, Anarchy, which permits no other restraint upon individual freedom than "such ethical and intellectual considerations as may be fully recognised by the individual," and Regimentation, which undertakes to "regulate not only production and consumption, but every detail of human life." Both these theories are based upon the assumption of a state of nature which never existed and upon the unwarranted derivation of civil from natural rights. "Perhaps it is the prejudice of scientific habit," wrote Huxley, "which leads me to think that it might be as well to proceed from the known to the unknown." Therefore he maintained that the problems of government cannot be solved in the lump by reference to *a priori* formulæ but by facing the concrete problems as they appear. We can, however, learn from experience in self and family government to steer a middle course between rigid restraint and unlimited freedom.

IV

In his essay *On the Improvement of the Natural History Sciences* Huxley claimed for the study of science not only that it "conferred practical benefits on men,"

but, by changing "their conceptions of the universe and of themselves," "their modes of thinking and their views of right and wrong," it discovered "the ideas which can alone still spiritual cravings." Not everyone would find his spiritual cravings satisfied by so forbidding a moral system as Huxley's — certainly not one who had learned to rest comfortably in a religious belief which guarantees the ultimate triumph of good, which makes evil either a hideous but fleeting nightmare or a mysterious source of discipline and means to moral perfection, and which relieves him of responsibility for and voluntary share in the improvement of the world and of himself — beyond the acceptance of the opportunity offered him and obedience of the laws laid down for his guidance.

By applying in the field of religion the same principle that he used in every other field of knowledge, Huxley arrived first at negative results, the failure to find "logically satisfactory evidence" of the truth of religious doctrines or of such generally accepted beliefs as human immortality and the existence of a God. Therefore he accepted the "verdict of 'not proven'" though he regarded it as "undoubtedly unsatisfactory and essentially provisional, so far forth as the subject of the trial is capable of being dealt with by due process of reason." He wished, however, to give himself a label among "-ists of one sort or another" and to relieve himself of the name of atheist, materialist, and other opprobrious titles which implied that he had closed the case against religion. So he invented the title "agnostic" as "suggestively antithetic to the 'gnostic' of Church history, who professed to know so much about the very things of which I was ignorant," and for his principle, "agnosticism." Agnosticism he called a method rather than a creed, "except in so far as it expresses absolute faith in the validity of a principle, which is as much ethical

as intellectual." The essence of this principle is his theory of truth, "that it is wrong for a man to say that he is certain of the objective truth of any proposition unless he can produce evidence which logically justifies that certainty." On the other hand he denied and repudiated "as immoral . . . the contrary doctrine, that there are propositions which men ought to believe, without logically satisfactory evidence." In obedience to this principle he was unable to believe in the doctrine of immortality, since to do so seemed to him to mean accepting desire as a basis of truth. "Nor does it help to tell me that the aspirations of mankind—that my own highest aspirations even—lead me towards the doctrine of immortality. I doubt the fact, to begin with, but if it be so even, what is this but in grand words asking me to believe a thing because I like it."

Huxley's belief that even the evidence for religion must be subjected to the same test of verification as any other sort of truth led him to deny the accuracy of much Biblical and ecclesiastical history. His criticism of the "Mosaic" authorship of the Pentateuch and the traditional authorship of the Gospels, his challenge of the scientific correctness of the Biblical account of Creation and the Flood, and of the "demonology of primitive Christianity" brought upon him the unmerited reproach of hating Christianity and of wantonly attacking the Bible. As a result he became involved in a heated controversy with Gladstone and some less distinguished champions, who feared that the fate of religion itself depended upon the literal acceptance of ecclesiastical tradition as well as of the Bible. Two volumes of Huxley's *Collected Essays, Science and Hebrew Tradition*, and *Science and Christian Tradition*, contain his contributions to this controversy, and include some of his most

spirited writing. They are not represented in this book, however, for, as Huxley said, "few literary dishes are less appetising than cold controversy."

Although the principle of agnosticism made acceptance of orthodox religion impossible for Huxley, he was not without what he considered true religion, "the reverence and love for the ethical ideal, and the desire to realise that ideal in life, which every man ought to feel." To religion of this sort he held as firmly as to his ideal of truth, with which it is perhaps identical.

In the field of morals Huxley was therefore convinced that to "learn what is true, in order to do what is right," is the summing up of the whole duty of man, for all who are unable to satisfy their mental hunger with the east wind of authority." But where is moral truth to be found? Not in nature any more than in religious authority. Huxley found no evidence of moral and benevolent government in the universe. The governing principle of nature, by which he meant the "sum of the 'customs of matter'," he regarded as "intellectual and not moral." Yet he was disposed at times to find in nature one moral quality, justice. "The more I know intimately the lives of other men (to say nothing of my own), the more obvious it is to me that the wicked does *not* flourish nor is the righteous punished. But for this to be clear we must bear in mind . . . that the rewards of life are contingent upon obedience to the *whole* law—physical as well as moral—and that moral obedience will not atone for physical sin, or *vice versa*." This is perhaps less a description of a moral quality than a recognition of the operation in nature of the laws of cause and effect.

At any rate Huxley habitually regarded nature as the enemy of morality and of the society in which morality

flourishes. "Of moral purpose," he said, "I see no trace in Nature. That is an article of exclusively human manufacture — and very much to our credit." Huxley really has two systems of morality, one derived partly by the method he condemned, from *a priori* reasoning about the laws of nature and the laws of society, the other by observation and experiment. According to the first the law of nature is the law of the struggle for existence, and teaches man to cultivate self-assertion in order that he may survive in that struggle. The law which governs human society, on the other hand, "commands the sacrifice of the self to the common good" and develops the quality of self-restraint. But in making self-assertion the necessary virtue of man in a state of nature and self-restraint the virtue of man in society, Huxley was following not the evidence of experience but the old error of identifying the self with the lower impulses instead of with all man's interests. As a result he involves man in a hopeless dilemma. If he makes self-assertion the law of his being, society is impossible; if he makes self-restraint his law, he becomes the victim either of less virtuous men or of nature, which is always waiting to reduce him to the level from which he has risen by cultivating the opposite quality. Moreover he makes sympathy the basis of moral conduct and the "golden rule" a "negation of law by the refusal to put it in motion against law-breakers." What he overlooked is that man needs neither unlimited expansion nor mere restraint but development in the direction of a moral ideal.

In his other system of morals, which is not of course distinct from the one I have just briefly described, Huxley recognised that men have such moral ideals. The aim of morality is then the preservation of society so that the "individual may reach the fullest and highest

life attainable by man." And the means of attaining this end are "discoverable—like the other so-called laws of Nature—by observation and experiment, and only in that way." The rules of the game of life Huxley compares to the draughtsman's rules for perspective. The moral man has also a "moral sense" or "innate sense of moral beauty" analogous to the artistic sense and stronger in some men than in others. This moral sense furnishes its possessors with the motive for doing their duty which must be supplied to others by the "fear of punishment in all its grades, from mere disapprobation to hanging." These "men of moral genius" give us our "ideals of duty and visions of moral perfection, which ordinary mankind could never have attained: though, happily for them, they can feel the beauty of a vision" and can endeavour to reproduce "some faint image of it in the actual world." They furnish the "ethical ideals" without which neither human beings nor human society can progress. On this basis Huxley asserts that "the moral law, like the laws of physical nature, rests in the long run upon instinctive intuitions, and is neither more nor less 'innate' and 'necessary' than they are." That it is still, like the laws of physical nature, is discovered and verified by observation and experience.

But Huxley saw two finally insuperable obstacles put by non-moral nature in the way of man's progress toward his ideal of moral perfection: over-population, which would eventually throw him back into the struggle for existence, and the reversal of the evolutionary progress, which would make his efforts useless. The contemplation of this losing fight is infinitely depressing—or would be to one of less indomitable courage than Huxley. In the conflict with nature man, he says, "in virtue of his intelligence" is able so to "influence and modify the

cosmic process" as visibly to improve his condition. And this road of progress toward human perfection can be followed so long as the process of evolution continues on an upward course, but, "some time, the summit will be reached and the downward route will be commenced. The most daring imagination will hardly venture upon the suggestion that the power and intelligence of man can ever arrest the procession of the great year." In the face of the ultimate catastrophe when the cooling globe will have finally triumphed over human effort, Huxley had to find what comfort he could nearer at hand. "There is nothing of permanent value," he wrote in 1890 "(putting aside a few human affections), nothing that satisfies quiet reflection — except the sense of having worked according to one's capacity and light, to make things clear and get rid of cant and shams of all sorts."

In the case of the individual he saw also no end to the struggle between the law of nature and the law of morality, and the outcome was no more cheering. "The motive of the drama of human life is the necessity, laid upon every man who comes into the world, of discovering the mean between self-assertion and self-restraint suited to his character and his circumstances. And the eternally tragic aspect of the drama lies in this: that the problem set before us is one the elements of which can be but imperfectly known, and of which even an approximately right solution rarely presents itself, until that stern critic, aged experience, has been furnished with ample justification for venting his sarcastic humour upon the irreparable blunders we have already made."

The gloom of Huxley's view of the universe is increased by the ideas of human freedom and necessity which he sometimes, but not consistently, held. To be sure, his view at its gloomiest is, as he said, no more

deterministic than Jonathan Edwards's, but he himself rejected the *tu quoque* argument. And at times he expressed other ideas which, had they been definitely connected with his idea of evolution, could have produced a conception of a growing world in which new yet not uncaused events occur. On the side of determinism he held that men are but "conscious automata, endowed with free will in the only intelligible sense of that much-abused term — inasmuch as in many respects we are able to do as we like — but none the less parts of the great series of causes and events which, in unbroken continuity, composes that which is, and has been, and shall be — the sum of existence." This is of course not consistent with his belief in man's ability to modify his environment and to realize even partly his moral ideals. But his explanation that the idea of necessity has a "logical, and not a physical foundation" is more hopeful. And his distinction between necessity and law is quite in accord with his theory of truth: "Necessary," he says, means "that of which we cannot conceive the contrary," and "law" is "a rule which we have always found to hold good, and which we expect always will hold good." On this basis he is justified in condemning the way in which the "notion of necessity" has been "illegitimately thrust into the perfectly legitimate conception of law" by changing "*will* into *must*." It is unfortunate for Huxley's reputation as an ethical philosopher that he did not hold more firmly to the ideas thus briefly indicated, and develop them in connection with his other ideas of human progress towards a moral ideal.

In spite of the gloomy view he took of both the immediate and the ultimate result of human effort, so long as both good and evil exist and any amelioration is possible, Huxley repudiated pessimism as firmly as op-

timism. And his useful life, his courageous spirit, and his firm belief that in spite of pain, sorrow, and evil, life is well worth living, and that "escape from pain and sorrow" is not the "proper object of life," silence the accusation that springs to one's lips. All philosophical questions resolved themselves for him into one, "What can I know?" and where he found knowledge unattainable, he was content to remain an agnostic. And if his agnosticism permitted him no abiding faith in the future, he had at least an enduring heart for the trials of the present.

"I doubt, or at least I have no confidence in, the doctrine of ultimate happiness, and I am more inclined to look the opposite possibility fully in the face, and if that also be inevitable, make up my mind to bear it also.

"You will tell me there are better consolations than Stoicism; that may be, but I do not possess them, and I have found my 'grin and bear it' philosophy stand me in such good stead in my course through oceans of disgust and chagrin, that I should be loth to give it up."

V

The same strict regard for truth that distinguished all Huxley's work was, I cannot but believe, the secret of his beautiful and lucid way of writing. His theory of style was to use "such language that you can stand cross-examination on each word," and his friends testified to his remarkable sense for the right word. "I have a great love and respect for my native tongue," he wrote, "and take great pains to use it properly. Sometimes I write essays half-a-dozen times before I can get them into the proper shape; and I believe I become more fastidious as I grow older."

But style was not merely a matter of words; it was, he said, the "striving after the clear and forcible expression of definite conceptions; in which process the Glassian precept, 'first catch your definite conceptions,' is probably the most difficult to obey." Indeed his style is so much a part of his matter that an unfriendly critic, wishing to show that he was no great speaker, said that "all he did was to set some interesting theory unadorned before his audience, when such success as he attained was due to the compelling nature of the subject itself."

No tribute to his style could be more apt. Being always master of his subject, he is able to lead his reader through the intricacies of a complicated explanation or argument so as to make it not only clear but apparently simple. His method of arriving at general truths by way of particular facts stood him in good stead. Accustomed to deal with details, his words are always "really clothed with meaning," and he had always ready an appropriate illustration or analogy. Equally accustomed to analyse, to weigh ideas, and to relate them to one another, he was able to set forth his own ideas with logical precision and in due order. He never hurries the reader into the subject, but carefully prepares the ground. Although illustrations abound, he never really digresses. There is a constant forward movement toward the conclusion, which is reached with at least satisfaction and often with admiration of the skill with which the thought has been developed. Nor has he the defects which are often associated with precision and logic. His style is fresh, interesting, and varied, sometimes colloquial and homely, sometimes dignified and impressive. There is a great deal of humour, now genial, now biting, ironical, or grim. And there is often a rich literary flavour that shows not only familiarity with the great English classics and the Bible, but also acquaintance with classical literature.

Most of all there is the vigorous and genial personality of a man who was not merely a scientist, nor even merely a seeker after truth in itself, but who felt the need of relating all knowledge to human life, who approved the English pre-occupation with religion and politics, and who turned more and more as years went on from pure science to broader fields of interest.

SUGGESTIONS FOR STUDY

THERE are at least two good reasons for studying Huxley's essays in college classes—his style and his ideas. The editor does not wish to annoy the student or teacher with numerous suggestions for the study of either. What are here offered will perhaps serve as points of departure for one who may feel somewhat at a loss how to commence. The questions on style are pretty conventional; they aim simply to bring out qualities useful to students of composition. The questions on thought do not inquire what Huxley's thought is, but seek rather to extend its application to modern conditions, to test its value or soundness, and to suggest similar or different ideas which may be made subjects for composition or class discussion.

The content of each essay and the development of the thought as a whole can best be brought out by making a complete sentence outline of it. Such an outline should commence with a summary of the whole essay in a single complex sentence in which dependent clauses contain subordinate ideas, and independent clauses, principal ideas. The main topics should be similarly summarised, and the points in development of them, and so on. These sentences should be arranged in outline form with appropriate symbols, I, A, 1, a, etc., to indicate their logical relations. This exercise, though difficult at first, is valuable not only for the analysis of others' essays, but also in developing logical processes of thinking, and in furnishing models for outlines for original compositions. Having made such an outline, the student can easily study the structure of the whole.

QUESTIONS

Structure and Style. What is the method of development of the whole essay? Are there many or few main points. Are all given equal development? Can you explain the distribution of emphasis? Are there any digressions?

Compare the introductions of the various essays. Are they effective? Can you suggest a reason why each begins as it does? Can you suggest a better introduction?

Study the conclusions of the essays in the same way.

Can you summarise each paragraph in a sentence? What provision is made for transition? Is the thought developed more often by passing from general to particular, or the reverse? Does Huxley make use of enumeration? summaries? topic sentences? If there is a topic sentence, where is it placed? How is it developed?

Are sentences predominately long, short, or varied? What effect is produced by each kind? Can you find examples of the effective use of parallel constructions, periodic sentences, balance, antithesis, and climax? Can you find sentences that seem to you composed with great care, and others that seem to you rough?

Find examples of words that are technical, colloquial, quaint, antiquated, precise, abstract, concrete. Does Huxley's vocabulary seem to you varied? appropriate? carefully chosen? Find examples of literary allusions. From what sources are they chiefly taken? Are figures of speech used to any considerable extent? What figures are most often used?

Essays.

AUTOBIOGRAPHY. Does Huxley's *Autobiography* seem to you to bring out the chief events in his life? Upon what part of his life does it dwell chiefly? What seem to you to be its defects as biography? Read a life of Huxley in the *Dictionary of National Biography* or *Encyclopedia Britannica* and compare the details there selected with those in the *Autobiography*. How do you explain Huxley's choice of details? Why is the *Autobiography* interesting? Do you think from your reading of Huxley and from his biography that he succeeded in the objects to which he refers in the last paragraphs of his *Autobiography*?

ON IMPROVING NATURAL KNOWLEDGE. Why do you think the introduction to this essay is so impressive? What does Huxley gain by commencing with the plague and the fire? What were the great achievements of the sixteen centuries which he describes as lacking in material progress? Does he adequately develop his claim that the improvement of natural knowledge has changed the ethical ideals of men? What are the "foundations of a new morality" which he says are laid in this way? Is it really a *new* morality? Is his conception of the "old" morality altogether accurate?

METHOD OF SCIENTIFIC INVESTIGATION. Does the objective existence of the material world depend upon Huxley's theory of matter as its "substratum?" Is there any other theory of causation besides Huxley's? How else are the "laws of Nature" defined?

PROLEGOMENA. How does observation of a country side lead into the subject of evolution? What aspect of the evolutionary process does the introduction most emphasise? Why is the familiar metaphor of a "chain" and "links" inappropriate to represent the evolutionary process?

To what extent is the creation theory consistent with the theory of evolution? What "knowledge" is the basis of Huxley's "faith" in an "eternal order?" To what extent did over-population and the struggle for existence operate as a cause of the Great War? Why did these factors operate differently in France, Great Britain, Germany, and the United States?

Cite illustrations to show that self-restraint is not the "essence of the ethical process." How does Huxley's idea of the self lead him into this mistake? Why is his interpretation of the "golden rule" inaccurate?

Can you cite any evidence of the operation of any process of natural selection in American social, political, or industrial life today? of direct selection? Cite illustrations to show how the struggle for the means of enjoyment affects modern society, socially, politically, or industrially? What human faculties, types, and classes are most favoured by the conditions of modern life? What conditions in modern American life tend to favour a religious, intellectual, artistic, or democratic ideal?

THE STRUGGLE FOR EXISTENCE IN HUMAN SOCIETY. Is absolute self-negation a step in the direction of moral perfection? To what extent is the United States a nation of shop-keepers? To what extent is Huxley's discussion of the industrial problem in England applicable to the United States today? Are there any new factors in the present situation?

To what extent are the three kinds of special scientific training of which Huxley speaks available in the United States? By what agencies is special industrial training usually provided in this country? Have we any effective kind of "capacity-catching machinery?" How has the interest in technical training affected the curricula of our public schools? Is the technical training there offered

generally practical and efficient? What evidence does Huxley give of not wholly trusting "the people?" How did he wish to safeguard the welfare of communities against the dangers to which he thought them liable from a too democratic government? Do you approve his caution?

SCIENCE AND CULTURE. To what extent is this address an argument? How does its argumentative character affect the introduction and method of development? Just what is the issue? What is Huxley's attitude toward his "opponents" throughout this address? Is the kind of classical education that Huxley opposes offered in American colleges? To what extent is the kind of education he favours offered in America?

This address and that on *Science and Art* should be carefully compared with Matthew Arnold's address on *Literature and Science* to discover exactly how much Arnold and Huxley differ in their educational ideas.

A LIBERAL EDUCATION. Is the metaphor with which this extract begins effective? Is it accurate? Comment on the style of the extract.

SCIENCE AND ART. To what extent does education in the United States conform to Huxley's ideal? Can you plan a course of study for yourself in the college you are now attending which would conform both to Huxley's ideal and to the college requirements? If you cannot, where do you think the error lies? See also questions on *Science and Culture* above.

BIBLIOGRAPHY

This list, though not complete, includes Huxley's most important books and the standard biography.

- 1863 Evidence as to Man's Place in Nature.
1870 Lay Sermons, Addresses, and Reviews.
1871 Manual of the Anatomy of Vertebrated Animals.
1873 Critiques and Addresses.
1877 Anatomy of Invertebrated Animals.
1877 American Addresses.
1877 Physiography.
1878 Hume. English Men of Letters Series.
1879 The Crayfish; an introduction to the Study of Zoology.
1880 Introductory Science Primer.
1881 Science and Culture, and other Essays.
1891 Social Diseases and Worse Remedies.
1892 Essays on some Controverted Questions.
1893 Evolution and Ethics.
1893-4 Collected Essays: I. Methods and Results; II. Darwiniana; III. Science and Education; IV. Science and Hebrew Tradition; V. Science and Christian Tradition; VI. Hume, with Helps to the Study of Berkeley; VII. Man's Place in Nature; VIII. Discourses, Biological and Geological; IX. Evolution and Ethics and other Essays.
1898- Scientific Memoirs.
1916 Life and Letters of Thomas Henry Huxley. By his Son, Leonard Huxley. Two Volumes.

READINGS FROM HUXLEY

AUTOBIOGRAPHY¹

And when I consider, in one view, the many things . . . which I have upon my hands, I feel the burlesque of being employed in this manner at my time of life. But, in another view, and taking in all circumstances, these things, as trifling as they may appear, no less than things of greater importance, seem to be put upon me to do.—*Bishop Butler*² to the Duchess of Somerset.

THE "many things" to which the Duchess's correspondent here refers are the repairs and improvements of the episcopal seat at Auckland. I doubt if the great apologist, greater in nothing than in the simple dignity of his character, would have considered the writing an account of himself as a thing which could be put upon him to do whatever circumstances might be taken in. But the good bishop lived in an age when a man might write books and yet be permitted to keep his private

¹ The *Autobiography* was first published in a series of biographical sketches by C. Engel, 1890. Huxley wrote to his wife about it March 2, 1889: "A man who is bringing out a series of portraits of celebrities, with a sketch of their career attached, has bothered me out of my life for something to go with my portrait, and to escape the abominable bad taste of some of the notices, I have done that. I shall show it you before it goes back to Engel in proof."—*Life and Letters*, II:245.

² Joseph Butler (1692-1752) was bishop of Durham, and author of *The Analogy of Religion, Natural and Revealed, to the Constitution and Course of Nature*, 1736, an important defense of Christian theology. Huxley said he believed in the "great principle of the 'Analogy,'" but he preferred his own statement of it: "There is no absurdity in theology so great that you cannot parallel it by a greater absurdity of Nature."—*Life and Letters*, I:259.

existence to himself; in the pre-Boswellian epoch, when the germ of the photographer lay concealed in the womb of the distant future, and the interviewer who pervades our age was an unforeseen, indeed unimaginable, birth of time.

At present, the most convinced believer in the aphorism "*Bene qui latuit, bene vixit*,"³ is not always able to act up to it. An importunate person informs him that his portrait is about to be published and will be accompanied by a biography which the importunate person proposes to write. The sufferer knows what that means; either he undertakes to revise the "biography" or he does not. In the former case, he makes himself responsible; in the latter, he allows the publication of a mass of more or less fulsome inaccuracies for which he will be held responsible by those who are familiar with the prevalent art of self-advertisement. On the whole, it may be better to get over the "burlesque of being employed in this manner" and do the thing himself.

It was by reflections of this kind that, some years ago, I was led to write and permit the publication of the subjoined sketch.

I was born about eight o'clock in the morning on the 4th of May, 1825, at Ealing, which was, at that time, as quiet a little country village as could be found within half-a-dozen miles of Hyde Park Corner. Now it is a suburb of London with, I believe, 30,000 inhabitants. My father was one of the masters in a large semi-public school which at one time had a high reputation. I am not aware that any portents preceded my arrival in this world, but, in my childhood, I remember hearing a

³ "He who has lived a quiet life has lived well."—Ovid: *Tristia*, 3, 4, 25.

traditional account of the manner in which I lost the chance of an endowment of great practical value. The windows of my mother's room were open, in consequence of the unusual warmth of the weather. For the same reason, probably, a neighbouring beehive had swarmed, and the new colony, pitching on the windowsill, was making its way into the room when the horrified nurse shut down the sash. If that well-meaning woman had only abstained from her ill-timed interference, the swarm might have settled on my lips, and I should have been endowed with that mellifluous eloquence which, in this country, leads far more surely than worth, capacity, or honest work, to the highest places in Church and State. But the opportunity was lost, and I have been obliged to content myself through life with saying what I mean in the plainest of plain language, than which, I suppose, there is no habit more ruinous to a man's prospects of advancement.

Why I was christened Thomas Henry I do not know; but it is a curious chance that my parents should have fixed for my usual denomination upon the name of that particular Apostle with whom I have always felt most sympathy. Physically and mentally I am the son of my mother so completely—even down to peculiar movements of the hands, which made their appearance in me as I reached the age she had when I noticed them—that I can hardly find any trace of my father in myself, except an inborn faculty for drawing, which unfortunately, in my case, has never been cultivated, a hot temper, and that amount of tenacity of purpose which unfriendly observers sometimes call obstinacy.

My mother was a slender brunette, of an emotional and energetic temperament, and possessed of the most piercing black eyes I ever saw in a woman's head. With no more education than other women of the middle

classes in her day, she had an excellent mental capacity. Her most distinguishing characteristic, however, was rapidity of thought. If one ventured to suggest she had not taken much time to arrive at any conclusion, she would say: "I cannot help it, things flash across me." That peculiarity has been passed on to me in full strength; it has often stood me in good stead; it has sometimes played me sad tricks, and it has always been a danger. But, after all, if my time were to come over again, there is nothing I would less willingly part with than my inheritance of mother wit.

I have next to nothing to say about my childhood. In later years my mother, looking at me almost reproachfully, would sometimes say, "Ah! you were such a pretty boy!" whence I had no difficulty in concluding that I had not fulfilled my early promise in the matter of looks. In fact, I have a distinct recollection of certain curls of which I was vain, and of a conviction that I closely resembled that handsome, courtly gentleman, Sir Herbert Oakley, who was vicar of our parish, and who was as a god to us country folk, because he was occasionally visited by the then Prince George of Cambridge. I remember turning my pinafore wrong side forwards in order to represent a surplice, and preaching to my mother's maids in the kitchen as nearly as possible in Sir Herbert's manner one Sunday morning when the rest of the family were at church. That is the earliest indication I can call to mind of the strong clerical affinities which my friend Mr. Herbert Spencer⁴

⁴ Herbert Spencer (1820-1903) was a very original and important philosopher and friend of Huxley. Like Huxley he helped to extend the application of the theory of evolution, particularly in pure and social science. He devoted himself to the development of a "Synthetic Philosophy" and the unification of knowledge by the formulation of laws which hold good for all orders of phenomena. Huxley once pointed out his weakness

has always ascribed to me, though I fancy they have for the most part remained in a latent state.

My regular school training was of the briefest, perhaps fortunately, for though my way of life has made me acquainted with all sorts and conditions of men, from the highest to the lowest, I deliberately affirm that the society I fell into at school was the worst I have ever known. We boys were average lads, with much the same inherent capacity for good and evil as any others; but the people who were set over us cared about as much for our intellectual and moral welfare as if they were baby-farmers. We were left to the operation of the struggle for existence among ourselves, and bullying was the least of the ill practices current among us. Almost the only cheerful reminiscence in connection with the place which arises in my mind is that of a battle I had with one of my classmates, who had bullied me until I could stand it no longer. I was a very slight lad, but there was a wild-cat element in me which, when roused, made up for lack of weight, and I licked my adversary effectually. However, one of my first experiences of the extremely rough-and-ready nature of justice, as exhibited by the course of things in general, arose out of the fact that I—the victor—had a black eye, while he—the vanquished—had none, so that I got into disgrace and he did not. We made it up, and thereafter I was unmolested. One of the greatest shocks I ever received in my life was to be told a dozen years afterwards by the groom who brought me my horse in a stable-yard in Sydney that he was my quondam antagonist. He had a long story

for the deductive method of reasoning in the jesting remark that "if Spencer ever wrote a tragedy, its plot would be the slaying of a beautiful deduction by an ugly fact."—*Life and Letters of Herbert Spencer*, II:264.

of family misfortune to account for his position, but at that time it was necessary to deal very cautiously with mysterious strangers in New South Wales, and on inquiry I found that the unfortunate young man had not only been "sent out," but had undergone more than one colonial conviction.

As I grew older, my great desire was to be a mechanical engineer, but the fates were against this and, while very young, I commenced the study of medicine under a medical brother-in-law. But, though the Institute of Mechanical Engineers would certainly not own me, I am not sure that I have not all along been a sort of mechanical engineer *in partibus infidelium*.⁵ I am now occasionally horrified to think how very little I ever knew or cared about medicine as the art of healing. The only part of my professional course which really and deeply interested me was physiology, which is the mechanical engineering of living machines; and, notwithstanding that natural science has been my proper business, I am afraid there is very little of the genuine naturalist in me. I never collected anything, and species work was always a burden to me; what I cared for was the architectural and engineering part of the business, the working out of the wonderful unity of plan in the thousands and thousands of diverse living constructions, and the modifications of similar apparatuses to serve diverse ends. The extraordinary attraction I felt towards the study of the intricacies of living structure nearly proved fatal to me at the outset. I was a mere boy—I think between thirteen and fourteen years of age—when I was taken by some older student friends of mine to the first *post-mortem* examination I ever attended. All my life I have been most unfortunately sensitive to the disagreeables which

⁵ "In the faction of the unfaithful."

attend anatomical pursuits, but on this occasion my curiosity overpowered all other feelings, and I spent two or three hours in gratifying it. I did not cut myself and none of the ordinary symptoms of dissection-poison supervened, but poisoned I was somehow, and I remember sinking into a strange state of apathy. By way of a last chance, I was sent to the care of some good, kind people, friends of my father's, who lived in a farmhouse in the heart of Warwickshire. I remember staggering from my bed to the window on the bright spring morning after my arrival, and throwing open the casement. Life seemed to come back on the wings of the breeze, and to this day the faint odor of wood-smoke, like that which floated across the farm-yard in the early morning, is as good to me as the "sweet south upon a bed of violets." I soon recovered, but for years I suffered from occasional paroxysms of internal pain, and from that time my constant friend, hypochondriacal dyspepsia, commenced his half century of co-tenancy of my fleshly tabernacle.

Looking back on my "Lehrjahre,"⁶ I am sorry to say that I do not think that any account of my doings as a student would tend to edification. In fact, I should distinctly warn ingenuous youth to avoid imitating my example. I worked extremely hard when it pleased me, and when it did not—which was a very frequent case—I was extremely idle (unless making caricatures of one's pastors and masters is to be called a branch of industry), or else wasted my energies in wrong directions. I read everything I could lay hands upon, including novels, and took up all sorts of pursuits to drop them again quite as speedily. No doubt it was very largely my own fault, but the only instruction from which I ever obtained the proper effect of educa-

⁶ "Apprenticeship."

tion was that which I received from Mr. Wharton Jones, who was the lecturer on physiology at the Charing Cross School of Medicine. The extent and precision of his knowledge impressed me greatly, and the severe exactness of his method of lecturing was quite to my taste. I do not know that I have ever felt so much respect for anybody as a teacher before or since. I worked hard to obtain his approbation, and he was extremely kind and helpful to the youngster who, I am afraid, took up more of his time than he had any right to do. It was he who suggested the publication of my first scientific paper—a very little one—in the *Medical Gazette* of 1845,⁷ and most kindly corrected the literary faults which abounded in it, short as it was; for at that time, and for many years afterwards, I detested the trouble of writing, and would take no pains over it.

It was in the early spring of 1846, that, having finished my obligatory medical studies and passed the first M.B. examination at the London University—though I was still too young to qualify at the College of Surgeons—I was talking to a fellow-student (the present eminent physician, Sir Joseph Fayrer), and wondering what I should do to meet the imperative necessity for earning my own bread, when my friend suggested that I should write to Sir William Burnett, at that time Director-General for the Medical Service of the Navy, for an appointment. I thought this rather a strong thing to do, as Sir William was personally unknown to me, but my cheery friend would not listen to my scruples, so I went to my lodgings and wrote the best letter I could devise. A few days afterwards I received the usual official circular acknowledgment, but at the

⁷ The subject of Huxley's first paper was "On a Hitherto Undescribed Structure in the Human Hair Sheath."

bottom there was written an instruction to call at Somerset House on such a day. I thought that looked like business, so at the appointed time I called and sent in my card, while I waited in Sir William's ante-room. He was a tall, shrewd-looking old gentleman, with a broad Scotch accent — and I think I see him now as he entered with my card in his hand. The first thing he did was to return it, with the frugal reminder that I should probably find it useful on some other occasion. The second was to ask whether I was an Irishman. I suppose the air of modesty about my appeal must have struck him. I satisfied the Director-General that I was English to the backbone, and he made some inquiries as to my student career, finally desiring me to hold myself ready for examination. Having passed this, I was in Her Majesty's Service, and entered on the books of Nelson's old ship, the *Victory*, for duty at Haslar Hospital, about a couple of months after I made my application.

My official chief at Haslar was a very remarkable person, the late Sir John Richardson, an excellent naturalist, and far-famed as an indomitable Arctic traveller. He was a silent, reserved man, outside the circle of his family and intimates; and, having a full share of youthful vanity, I was extremely disgusted to find that "Old John," as we irreverent youngsters called him, took not the slightest notice of my worshipful self either the first time I attended him, as it was my duty to do, or for some weeks afterwards. I am afraid to think of the lengths to which my tongue may have run on the subject of the churlishness of the chief, who was, in truth, one of the kindest-hearted and most considerate of men. But one day, as I was crossing the hospital square, Sir John stopped me, and heaped coals of fire on my head by telling me that he had tried to get me

one of the resident appointments, much coveted by the assistant surgeons, but that the Admiralty had put in another man. "However," said he, "I mean to keep you here till I can get you something you will like," and turned upon his heel without waiting for the thanks I stammered out. That explained how it was I had not been packed off to the West Coast of Africa like some of my juniors, and why, eventually, I remained altogether seven months at Haslar.

After a long interval, during which "Old John" ignored my existence almost as completely as before, he stopped me again as we met in a casual way, and describing the service on which the *Rattlesnake* was likely to be employed, said that Captain Owen Stanley, who was to command the ship, had asked him to recommend an assistant surgeon who knew something of science; would I like that? Of course I jumped at the offer. "Very well, I give you leave; go to London at once and see Captain Stanley." I went, saw my future commander, who was very civil to me, and promised to ask that I should be appointed to his ship, as in due time I was. It is a singular thing that, during the few months of my stay at Haslar, I had among my messmates two future Directors-General of the Medical Service of the Navy (Sir Alexander Armstrong and Sir John Watt-Reid), with the present President of the College of Physicians and my kindest of doctors, Sir Andrew Clark.

Life on board her Majesty's ships in those days was a very different affair from what it is now, and ours was exceptionally rough, as we were often many months without receiving letters or seeing any civilized people but ourselves. In exchange, we had the interest of being about the last voyagers, I suppose, to whom it could be possible to meet with people who knew nothing of fire-arms — as we did on the south coast of New Guinea —

and of making acquaintance with a variety of interesting savage and semi-civilized people. But, apart from experience of this kind and the opportunities offered for scientific work, to me, personally, the cruise was extremely valuable. It was good for me to live under sharp discipline; to be down on the realities of existence by living on bare necessities; to find out how extremely well worth living life seemed to be when one woke up from a night's rest on a soft plank, with the sky for canopy and cocoa and weevilly biscuit the sole prospect for breakfast; and, more especially, to learn to work for the sake of what I got for myself out of it, even if it all went to the bottom and I along with it. My brother officers were as good fellows as sailors ought to be and generally are, but, naturally, they neither knew nor cared anything about my pursuits, nor understood why I should be so zealous in pursuit of the objects which my friends, the middies, christened "Buffons," after the title conspicuous on a volume of the "Suites à Buffon," which stood on my shelf in the chart-room.

During the four years of our absence, I sent home communication after communication to the "Linnean Society,"⁸ with the same result as that obtained by Noah when he sent the raven out of his ark. Tired at last of hearing nothing about them, I determined to do or die, and in 1849 I drew up a more elaborate paper and forwarded it to the Royal Society.⁹ This was my dove, if I had only known it. But owing to the movements of the ship, I heard nothing of that either until my return to

⁸ The Linnean Society for the promotion of zoology and botany was founded in 1788 to supplement the work of the Royal Society.

⁹ The Royal Society of London for Improving Natural Knowledge is the oldest scientific society in Great Britain. Huxley gives an account of its founding in his lecture *On the Advisableness of Improving Natural Knowledge*, in this volume, p. 18.

England in the latter end of the year 1850, when I found that it was printed and published, and that a huge packet of separate copies awaited me. When I hear some of my young friends complain of want of sympathy and encouragement, I am inclined to think that my naval life was not the least valuable part of my education.

Three years after my return were occupied by a battle between my scientific friends on the one hand and the Admiralty on the other, as to whether the latter ought, or ought not, to act up to the spirit of a pledge they had given to encourage officers who had done scientific work by contributing to the expense of publishing mine. At last the Admiralty, getting tired, I suppose, cut short the discussion by ordering me to join a ship, which thing I declined to do, and as Rastignac, in the *Père Goriot*, says to Paris, I said to London "*à nous deux.*"¹⁰ I desired to obtain a Professorship of either Physiology or Comparative Anatomy, and as vacancies occurred I applied, but in vain. My friend, Professor Tyndall,¹¹ and I were candidates at the same time, he for the Chair of Physics and I for that of Natural History in the University of Toronto, which, fortunately, as it turned out, would not look at either of us. I say fortunately, not from any lack of respect for Toronto, but because I soon made up my mind that London was

¹⁰ "(It's) between us two."

¹¹ John Tyndall (1820-1893) was a distinguished scientist and natural philosopher. Besides making important scientific discoveries, Tyndall, like Huxley, helped to disseminate the important scientific ideas of his day and to render them intelligible to laymen. Huxley regarded Tyndall as more successful than he was in conciliating his audiences, and wrote him on the occasion of a lecture "On the Scientific Uses of the Imagination": "Those confounded parsons seem to me to let you say anything while they bully me for a word or a phrase. It's the old story, 'one man may steal a horse while the other may not look over the wall.'" — *Life and Letters*; I:331.

the place for me, and hence I have steadily declined the inducements to leave it, which have at various times been offered. At last, in 1854, on the translation of my warm friend Edward Forbes, to Edinburgh, Sir Henry De la Beche, the Director-General of the Geological Survey, offered me the post Forbes had vacated of Paleontologist and Lecturer on Natural History. I refused the former point blank, and accepted the latter only provisionally, telling Sir Henry that I did not care for fossils, and that I should give up Natural History as soon as I could get a physiological post. But I held the office for thirty-one years, and a large part of my work has been paleontological.

At that time I disliked public speaking, and had a firm conviction that I should break down every time I opened my mouth. I believe I had every fault a speaker could have (except talking at random or indulging in rhetoric), when I spoke to the first important audience I ever addressed, on a Friday evening at the Royal Institution,¹² in 1852. Yet, I must confess to having been guilty, *malgré moi*,¹³ of as much public speaking as most of my contemporaries, and for the last ten years it ceased to be so much of a bugbear to me. I used to pity myself for having to go through this training, but I am now more disposed to compassionate the unfortunate audiences, especially my ever-friendly hearers at the Royal Institution, who were the subjects of my oratorical experiments.

The last thing that it would be proper for me to do would be to speak of the work of my life, or to say at

¹² The Royal Institution is "an establishment in London for diffusing the knowledge of useful mechanical improvements." It was founded in 1799 to "teach the application of science to the useful purposes of life." Huxley described his appearance there in a letter to his sister, *Life and Letters*, I:106-107.

¹³ "In spite of myself."

the end of the day whether I think I have earned my wages or not. Men are said to be partial judges of themselves. Young men may be, I doubt if old men are. Life seems terribly foreshortened as they look back, and the mountain they set themselves to climb in youth turns out to be a mere spur of immeasurably higher ranges when, by failing breath, they reach the top. But if I may speak of the objects I have had more or less definitely in view since I began the ascent of my hillock, they are briefly these: To promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction which has grown with my growth and strengthened with my strength, that there is no alleviation for the sufferings of mankind except veracity of thought and of action, and the resolute facing of the world as it is when the garment of make-believe by which pious hands have hidden its uglier features is stripped off.

It is with this intent that I have subordinated any reasonable, or unreasonable, ambition for scientific fame which I may have permitted myself to entertain to other ends; to the popularisation of science; to the development and organisation of scientific education; to the endless series of battles and skirmishes over evolution; and to untiring opposition to that ecclesiastical spirit, that clericalism, which in England, as everywhere else, and to whatever denomination it may belong, is the deadly enemy of science.

In striving for the attainment of these objects, I have been but one among many, and I shall be well content to be remembered, or even not remembered, as such. Circumstances, among which I am proud to reckon the devoted kindness of many friends, have led to my occupation of various prominent positions, among which

the Presidency of the Royal Society is the highest. It would be mock modesty on my part, with these and other scientific honours which have been bestowed upon me, to pretend that I have not succeeded in the career which I have followed, rather because I was driven into it than of my own free will; but I am afraid I should not count even these things as marks of success if I could not hope that I had somewhat helped that movement of opinion which has been called the New Reformation.¹⁴

¹⁴ With respect to his part in this movement Huxley wrote to his wife in 1873: "The part I have to play is not to found a new school of thought or to reconcile the antagonisms of the old schools. We are in the midst of a gigantic movement greater than that which preceded and produced the Reformation, and really only the continuation of that movement. . . . But this organisation will be the work of generations of men, and those who further it most will be those who teach men to rest in no lie, and to rest in no verbal delusion. I may be able to help a little in this direction — perhaps I may have helped already."¹⁷
— *Life and Letters*, I:427-428.

ON THE ADVISABLENESS OF IMPROVING NATURAL KNOWLEDGE¹

THIS time two hundred years ago — in the beginning of January, 1666 — those of our forefathers who inhabited this great and ancient city, took breath between the shocks of two fearful calamities: one not quite past, although its fury had abated; the other to come.

Within a few yards of the very spot on which we are assembled, so the tradition runs, that painful and deadly malady, the plague, appeared in the latter months of 1664; and, though no new visitor, smote the people of England, and especially of her capital, with a violence unknown before, in the course of the following year. The hand of a master has pictured what happened in those dismal months; and in that truest of fictions, "The History of the Plague Year," Defoe shows death, with every accompaniment of pain and terror, stalking

¹ This lay sermon was delivered in St. Martin's Hall, January 7, 1866, and was subsequently published in the *Fortnightly Review* and in *Methods and Results, Collected Essays*, I. Twelve years earlier Huxley had delivered in the same place an address *On the Educational Value of the Natural History Sciences* in which he advanced similar ideas. He said of the scientific method on that occasion: "So far as I can arrive at any clear comprehension of the matter, Science is not, as many would seem to suppose, a modification of the black art, suited to the tastes of the nineteenth century, and flourishing mainly in consequence of the decay of the Inquisition.

"Science is, I believe, nothing but *trained and organised common sense*, differing from the latter only as a veteran may differ from a raw recruit." — *Science and Education, Collected Essays*, III:45.

through the narrow streets of old London, and changing their busy hum into a silence broken only by the wailing of the mourners of fifty thousand dead; by the woful denunciations and mad prayers of fanatics; and by the madder yells of despairing profligates.

But, about this time in 1666, the death-rate had sunk to nearly its ordinary amount; a case of plague occurred only here and there, and the richer citizens who had flown from the pest had returned to their dwellings. The remnant of the people began to toil at the accustomed round of duty, or of pleasure; and the stream of city life bid fair to flow back along its old bed, with renewed and uninterrupted vigour.

The newly kindled hope was deceitful. The great plague, indeed, returned no more; but what it had done for the Londoners, the great fire, which broke out in the autumn of 1666, did for London; and, in September of that year, a heap of ashes and the indestructible energy of the people were all that remained of the glory of five-sixths of the city within the walls.

Our forefathers had their own ways of accounting for each of these calamities. They submitted to the plague in humility and in penitence, for they believed it to be the judgment of God. But, towards the fire they were furiously indignant, interpreting it as the effect of the malice of man,—as the work of the Republicans, or of the Papists, according as their prepossessions ran in favour of loyalty or of Puritanism.

It would, I fancy, have fared but ill with one who, standing where I now stand, in what was then a thickly-peopled and fashionable part of London, should have broached to our ancestors the doctrine which I now propound to you — that all their hypotheses were alike wrong; that the plague was no more, in their sense,

Divine judgment, than the fire was the work of any political, or of any religious, sect; but that they were themselves the authors of both plague and fire, and that they must look to themselves to prevent the recurrence of calamities, to all appearance so peculiarly beyond the reach of human control — so evidently the result of the wrath of God, or of the craft and subtlety of an enemy.

And one may picture to one's self how harmoniously the holy cursing of the Puritan of that day would have chimed in with the unholy cursing and the crackling wit of the Rochesters² and Sedleys,² and with the revilings of the political fanatics, if my imaginary plain dealer had gone on to say that, if the return of such misfortunes were ever rendered impossible, it would not be in virtue of the victory of the faith of Laud,³ or of that of Milton;⁴ and, as little, by the triumph of republicanism, as by that of monarchy. But that the one thing needful for compassing this end was, that the people of England should second the efforts of an insignificant corporation, the establishment of which, a few years before the epoch of the great plague and the great fire, had been as little noticed, as they were conspicuous.

Some twenty years before the outbreak of the plague a few calm and thoughtful students banded themselves together for the purpose, as they phrased it, of "improving natural knowledge." The ends they proposed

² John Wilmot, second Earl of Rochester, and Sir Charles Sedley were profligate wits and dramatists of the reign of Charles II.

³ William Laud, Archbishop of Canterbury, was a vigorous opponent of Puritanism. He was impeached by the Long Parliament and beheaded in 1645, four years before his master, Charles I.

⁴ John Milton, the poet, was Cromwell's Latin secretary and a staunch defender of the Puritan faith.

to attain cannot be stated more clearly than in the words of one of the founders of the organisation: —

“Our business was (precluding matters of theology and state affairs) to discourse and consider of philosophical enquiries, and such as related thereunto:—as Physick, Anatomy, Geometry, Astronomy, Navigation, Staticks, Magneticks, Chymicks, Mechanicks, and Natural Experiments; with the state of these studies and their cultivation at home and abroad. We then discoursed of the circulation of the blood, the valves in the veins, the *venæ lacteæ*, the lymphatic vessels, the Copernican hypothesis, the nature, of comets and new stars, the satellites of Jupiter, the oval shape (as it then appeared) of Saturn, the spots on the sun and its turning on its own axis, the inequalities and selenography of the moon, the several phases of Venus and Mercury, the improvement of telescopes and grinding of glasses for that purpose, the weight of air, the possibility or impossibility of vacuities and nature’s abhorrence thereof, the Torricellian experiment⁵ in quicksilver, the descent of heavy bodies and the degree of acceleration therein, with divers other things of like nature, some of which were then but new discoveries, and others not so generally known and embraced as now they are; with other things appertaining to what hath been called the New Philosophy, which, from the times of Galileo⁶ at Florence, and Sir Francis Bacon (Lord Verulam)⁷ in

⁵ The principle of the modern barometer had just been discovered, in 1643, by Evangelista Torricelli, an Italian physicist and friend of Galileo.

⁶ Galileo Galilei (1564-1642), the famous Italian astronomer, constructed a thermometer and a telescope, and discovered Jupiter’s satellites and the spots on the sun. His doctrines were condemned by the Pope and he was finally forced to abjure the Copernican theory.

⁷ Sir Francis Bacon (1561-1626) is usually credited with having greatly aided the progress of science by the development of the

England, hath been much cultivated in Italy, France, Germany, and other parts abroad, as well as with us in England."

The learned Dr. Wallis, writing in 1696, narrates, in these words, what happened half a century before, or about 1645. The associates met at Oxford, in the rooms of Dr. Wilkins, who was destined to become a bishop; and subsequently coming together in London, they attracted the notice of the king. And it is a strange evidence of the taste for knowledge which the most obviously worthless of the Stuarts shared with his father and grandfather, that Charles the Second was not content with saying witty things about his philosophers, but did wise things with regard to them.⁸ For he not only bestowed upon them such attention as he could spare from his poodles and his mistresses, but, being in his usual state of impecuniosity, begged for them of the Duke of Ormond; and, that step being without effect, gave them Chelsea College, a charter, and a mace: crowning his favours in the best way they could be crowned, by burdening them no further with royal patronage or state interference.

inductive method. Huxley, however, thought differently. He condemned Bacon's method as "hopelessly impracticable" and added that "the 'anticipation of nature' by the invention of hypotheses based on incomplete inductions, which he specially condemns, has proved itself to be a most efficient, indeed an indispensable, instrument of scientific progress."—*The Progress of Science, Methods and Results, Collected Essays*, I:47. Huxley's theory of the method of scientific investigation is given in the next selection.

⁸ The Earl of Rochester is said to have written the following lines on the door of Charles II's bedchamber:

"Here lies our sovereign lord the king,
Whose word no man relies on;
He never says a foolish thing
Nor never does a wise one."

Thus it was that the half-dozen young men, studious of the "New Philosophy," who met in one another's lodgings in Oxford or in London, in the middle of the seventeenth century, grew in numerical and in real strength, until, in its latter part, the "Royal Society for the Improvement of Natural Knowledge" had already become famous, and had acquired a claim upon the veneration of Englishmen, which it has ever since retained, as the principal focus of scientific activity in our islands, and the chief champion of the cause it was formed to support.

It was by the aid of the Royal Society that Newton published his "*Principia*."⁹ If all the books in the world, except the "*Philosophical Transactions*,"¹⁰ were destroyed, it is safe to say that the foundations of physical science would remain unshaken, and that the vast intellectual progress of the last two centuries would be largely, though incompletely, recorded. Nor have any signs of halting or of decrepitude manifested themselves in our own times. As in Dr. Wallis' days, so in these, "our business is, precluding theology and state affairs, to discourse and consider of philosophical enquiries." But our "Mathematick" is one which Newton would have to go to school to learn; our "Statics, Mechanics, Magneticks, Chymicks, and Natural Experiments" constitute a mass of physical and chemical knowledge, a glimpse at which would compensate Galileo for the doings of a score of inquisitorial cardinals; our "Physick" and "Anatomy" have embraced such infinite varieties of being, have laid open such new worlds in time and space, have grappled, not unsuccessfully, with

⁹ Newton's *Principia*, or *The Mathematical Principles of Natural Philosophy*, was published by the Royal Society in 1686.

¹⁰ The *Philosophical Transactions* has been since 1665 one of the regular publications of the Royal Society.

such complex problems, that the eyes of Vesalius¹¹ and of Harvey¹² might be dazzled by the sight of the tree that has grown out of their grain of mustard seed.

The fact is perhaps rather too much, than too little, forced upon one's notice, nowadays, that all this marvellous intellectual growth has a no less wonderful expression in practical life; and that, in this respect, if in no other, the movement symbolised by the progress of the Royal Society stands without a parallel in the history of mankind.

A series of volumes as bulky as the "Transactions of the Royal Society" might possibly be filled with the subtle speculations of the Schoolmen;¹³ not improbably, the obtaining a mastery over the products of mediæval thought might necessitate an even greater expenditure of time and of energy than the acquirement of the "New Philosophy"; but though such work engrossed the best intellects of Europe for a longer time than has elapsed since the great fire, its effects were "writ in water,"¹⁴ so far as our social state is concerned.

On the other hand, if the noble first President of the Royal Society could revisit the upper air and once more gladden his eyes with a sight of the familiar mace, he would find himself in the midst of a material civilisation more different from that of his day, than that of the

¹¹ Andreas Vesalius was a Belgian anatomist of the sixteenth century.

¹² William Harvey (1578-1657), a great English physiologist, is best known for his discovery and demonstration of the circulation of the blood.

¹³ The Schoolmen, who flourished during the Middle Ages, were engaged chiefly in fine-spun and dogmatic expositions of church doctrine or in such idle speculations as whether the angels speak the Hebrew language and how many of them can dance the Spanish Tarantella upon the point of a cambric needle.

¹⁴ The inscription upon Keats' tomb is, by his request, "Here lies one whose name was writ in water."

seventeenth was from that of the first century. And if Lord Brouncker's native sagacity had not deserted his ghost, he would need no long reflection to discover that all these great ships, these railways, these telegraphs, these factories, these printing-presses, without which the whole fabric of modern English society would collapse into a mass of stagnant and starving pauperism, — that all these pillars of our State are but the ripples and the bubbles upon the surface of that great spiritual stream, the springs of which, only he and his fellows were privileged to see; and seeing, to recognise as that which it behoved them above all things to keep pure and undefiled.

It may not be too great a flight of imagination to conceive our noble *revenant* not forgetful of the great troubles of his own day, and anxious to know how often London had been burned down since his time, and how often the plague had carried off its thousands. He would have to learn that, although London contains tenfold the inflammable matter that it did in 1666; though, not content with filling our rooms with woodwork and light draperies, we must needs lead inflammable and explosive gases into every corner of our streets and houses, we never allow even a street to burn down. And if he asked how this had come about, we should have to explain that the improvement of natural knowledge has furnished us with dozens of machines for throwing water upon fires, any one of which would have furnished the ingenious Mr. Hooke, the first "curator and experimenter" of the Royal Society, with ample materials for discourse before half a dozen meetings of that body; and that, to say truth, except for the progress of natural knowledge, we should not have been able to make even the tools by which these machines are constructed. And, further, it would be necessary to add, that although

severe fires sometimes occur and inflict great damage, the loss is very generally compensated by societies, the operations of which have been rendered possible only by the progress of natural knowledge in the direction of mathematics, and the accumulation of wealth in virtue of other natural knowledge.

But the plague? My Lord Brouncker's observation would not, I fear, lead him to think that Englishmen of the nineteenth century are purer in life, or more fervent in religious faith, than the generation which could produce a Boyle,¹⁵ an Evelyn,¹⁶ and a Milton. He might find the mud of society at the bottom, instead of at the top, but I fear that the sum total would be as deserving of swift judgment as at the time of the Restoration. And it would be our duty to explain once more, and this time not without shame, that we have no reason to believe that it is the improvement of our faith, nor that of our morals, which keeps the plague from our city; but, again, that it is the improvement of our natural knowledge.

We have learned that pestilences will only take up their abode among those who have prepared unswept and un-garnished residences for them. Their cities must have narrow, unwatered streets, foul with accumulated garbage. Their houses must be ill-drained, ill-lighted, ill-ventilated. Their subjects must be ill-washed, ill-fed,

¹⁵ Robert Boyle (1627-1691) is best known as a physicist and the discoverer of Boyle's law of the elasticity of gases. Huxley refers to him here, however, as the student and propagator of religion. He established by his will the "Boyle lectures" for the defense of Christianity against unbelievers.

¹⁶ John Evelyn (1620-1706), the diarist, is described by Leslie Stephen as "the typical instance of the accomplished and public-spirited country gentleman of the Restoration, a pious and devoted member of the Church of England and a staunch loyalist in spite of his grave disapproval of the members of the court." Both Boyle and Evelyn were members of the Royal Society.

ill-clothed. The London of 1665 was such a city. The cities of the East, where plague has an enduring dwelling, are such cities. We, in later times, have learned somewhat of Nature, and partly obey her. Because of this partial improvement of our natural knowledge and of that fractional obedience, we have no plague; because that knowledge is still very imperfect and that obedience yet incomplete, typhoid is our companion and cholera our visitor. But it is not presumptuous to express the belief that, when our knowledge is more complete and our obedience the expression of our knowledge, London will count her centuries of freedom from typhoid and cholera, as she now gratefully reckons her two hundred years of ignorance of that plague which swooped upon her thrice in the first half of the seventeenth century.

Surely, there is nothing in these explanations which is not fully borne out by the facts? Surely, the principles involved in them are now admitted among the fixed beliefs of all thinking men? Surely, it is true that our countrymen are less subject to fire, famine, pestilence, and all the evils which result from a want of command over and due anticipation of the course of Nature, than were the countrymen of Milton; and health, wealth, and well-being are more abundant with us than with them? But no less certainly is the difference due to the improvement of our knowledge of Nature, and the extent to which that improved knowledge has been incorporated with the household words of men, and has supplied the springs of their daily actions.

Granting for a moment, then, the truth of that which the depreciators of natural knowledge are so fond of urging, that its improvement can only add to the resources of our material civilisation; admitting it to be possible that the founders of the Royal Society themselves looked for no other reward than this, I cannot

confess that I was guilty of exaggeration when I hinted, that to him who had the gift of distinguishing between prominent events and important events, the origin of a combined effort on the part of mankind to improve natural knowledge might have loomed larger than the Plague and have outshone the glare of the Fire; as a something fraught with a wealth of beneficence to mankind, in comparison with which the damage done by those ghastly evils would shrink into insignificance.

It is very certain that for every victim slain by the plague, hundreds of mankind exist and find a fair share of happiness in the world, by the aid of the spinning jenny. And the great fire, at its worst, could not have burned the supply of coal, the daily working of which, in the bowels of the earth, made possible by the steam pump, gives rise to an amount of wealth to which the millions lost in old London are but as an old song.

But spinning jenny and steam pump are, after all, but toys, possessing an accidental value; and natural knowledge creates multitudes of more subtle contrivances, the praises of which do not happen to be sung because they are not directly convertible into instruments for creating wealth. When I contemplate natural knowledge squandering such gifts among men, the only appropriate comparison I can find for her is, to liken her to such a peasant woman as one sees in the Alps, striding ever upward, heavily burdened, and with mind bent only on her home; but yet without effort and without thought, knitting for her children. Now stockings are good and comfortable things, and the children will undoubtedly be much the better for them; but surely it would be short-sighted, to say the least of it, to depreciate this toiling mother as a mere stocking-machine — a mere provider of physical comforts?

However, there are blind leaders of the blind, and not a few of them, who take this view of natural knowledge, and can see nothing in the bountiful mother of humanity but a sort of comfort-grinding machine. According to them, the improvement of natural knowledge always has been, and always must be, synonymous with no more than the improvement of the material resources and the increase of the gratifications of men.

Natural knowledge is, in their eyes, no real mother of mankind, bringing them up with kindness, and, if need be, with sternness, in the way they should go, and instructing them in all things needful for their welfare; but a sort of fairy godmother, ready to furnish her pets with shoes of swiftness, swords of sharpness, and omnipotent Alladin's lamps, so that they may have telegraphs to Saturn, and see the other side of the moon, and thank God they are better than their benighted ancestors.

~~X~~ If this talk were true, I, for one, should not greatly care to toil in the service of natural knowledge. I think I would just as soon be quietly chipping my own flint axe after the manner of my forefathers a few thousand years back, as be troubled with the endless malady of thought which now infests us all, for such reward. But I venture to say that such views are contrary alike to reason and to fact. ~~X~~ Those who discourse in such fashion seem to me to be so intent upon trying to see what is above Nature, or what is behind her, that they are blind to what stares them in the face in her.

I should not venture to speak thus strongly if my justification were not to be found in the simplest and most obvious facts, — if it needed more than an appeal to the most notorious truths to justify my assertion, that the improvement of natural knowledge, whatever direction it has taken, and however low the aims of those who may have commenced it — has not only conferred

practical benefits on men, but, in so doing, has effected a revolution in their conceptions of the universe and of themselves, and has profoundly altered their modes of thinking and their views of right and wrong. I say that natural knowledge, seeking to satisfy natural wants, has found the ideas which can alone still spiritual cravings. I say that natural knowledge, in desiring to ascertain the laws of comfort, has been driven to discover those of conduct, and to lay the foundations of a new morality.

Let us take these points separately; and first, what great ideas has natural knowledge introduced into men's minds?

I cannot but think that the foundations of all natural knowledge were laid when the reason of man first came face to face with the facts of Nature; when the savage first learned that the fingers of one hand are fewer than those of both; that it is shorter to cross a stream than to head it; that a stone stops where it is unless it be moved, and that it drops from the hand which lets it go; that light and heat come and go with the sun; that sticks burn away in a fire; that plants and animals grow and die; that if he struck his fellow savage a blow he would make him angry, and perhaps get a blow in return, while if he offered him a fruit he would please him, and perhaps receive a fish in exchange. When men had acquired this much knowledge, the outlines, rude though they were, of mathematics, of physics, of chemistry, of biology, of moral, economical, and political science, were sketched. Nor did the germ of religion fail when science began to bud. Listen to words which, though new, are yet three thousand years old:—

“ . . . When in heaven the stars about the moon
 Look beautiful, when all the winds are laid,
 And every height comes out, and jutting peak

And valley, and the immeasurable heavens
 Break open to their highest, and all the stars
 Shine, and the shepherd gladdens in his heart." ¹⁷

If the half-savage Greek could share our feelings thus far, it is irrational to doubt that he went further, to find as we do, that upon that brief gladness there follows a certain sorrow, — the little light of awakened human intelligence shines so mere a spark amidst the abyss of the unknown and unknowable; seems so insufficient to do more than illuminate the imperfections that cannot be remedied, the aspirations that cannot be realised, of man's own nature. But in this sadness, this consciousness of the limitation of man, this sense of an open secret which he cannot penetrate, lies the essence of all religion; and the attempt to embody it in the forms furnished by the intellect is the origin of the higher theologies.

Thus it seems impossible to imagine but that the foundations of all knowledge — secular or sacred — were laid when intelligence dawned, though the superstructure remained for long ages so slight and feeble as to be compatible with the existence of almost any general view respecting the mode of governance of the universe. No doubt, from the first, there were certain phænomena which, to the rudest mind, presented a constancy of occurrence, and suggested that a fixed order ruled, at any rate, among them. I doubt if the grossest of Fetish worshippers ever imagined that a stone must have a god within it to make it fall, or that a fruit had a god within it to make it taste sweet. With regard to such matters as these, it is hardly questionable that mankind from the first took strictly positive and scientific views.

But, with respect to all the less familiar occurrences which present themselves, uncultured man, no doubt, has

¹⁷ Need it be said that this is Tennyson's English for Homer's Greek? [T. H. H.]

always taken himself as the standard of comparison, as the centre and measure of the world; nor could he well avoid doing so. And finding that his apparently uncaused will has a powerful effect in giving rise to many occurrences, he naturally enough ascribed other and greater events to other and greater volitions, and came to look upon the world and all that therein is, as the product of the volitions of persons like himself, but stronger, and capable of being appeased or angered, as he himself might be soothed or irritated. Through such conceptions of the plan and working of the universe all mankind have passed, or are passing. And we may now consider what has been the effect of the improvement of natural knowledge on the views of men who have reached this stage, and who have begun to cultivate natural knowledge with no desire but that of "increasing God's honour and bettering man's estate."

X For example, what could seem wiser, from a mere material point of view, more innocent, from a theological one, to an ancient people, than that they should learn the exact succession of the seasons, as warnings for their husbandmen; or the position of the stars, as guides to their rude navigators? But what has grown out of this search for natural knowledge of so merely useful a character? You all know the reply. Astronomy, — which of all sciences has filled men's minds with general ideas of a character most foreign to their daily experience, and has, more than any other, rendered it impossible for them to accept the beliefs of their fathers. Astronomy, — which tells them that this so vast and seemingly solid earth is but an atom among atoms, whirling, no man knows whither, through illimitable space; which demonstrates that what we call the peaceful heaven above us, is but that space, filled by an infinitely subtle matter whose particles are seething and surging, like the waves

of an angry sea; which opens up to us infinite regions where nothing is known, or ever seems to have been known, but matter and force, operating according to rigid rules; which leads us to contemplate phænomena the very nature of which demonstrates that they must have had a beginning, and that they must have an end, but the very nature of which also proves that the beginning was, to our conceptions of time, infinitely remote, and that the end is as immeasurably distant.

But it is not alone those who pursue astronomy who ask for bread and receive ideas. What more harmless than the attempt to lift and distribute water by pumping it; what more absolutely and grossly utilitarian? Yet out of pumps grew the discussions about Nature's abhorrence of a vacuum; and then it was discovered that Nature does not abhor a vacuum, but that air has weight; and that notion paved the way for the doctrine that all matter has weight, and that the force which produces weight is co-extensive with the universe, — in short, to the theory of universal gravitation and endless force. While learning how to handle gases led to the discovery of oxygen, and to modern chemistry, and to the notion of the indestructibility of matter.

Again, what simpler, or more absolutely practical, than the attempt to keep the axle of a wheel from heating when the wheel turns round very fast? How useful for carters and gig drivers to know something about this; and how good were it, if any ingenious person would find out the cause of such phænomena, and thence educe a general remedy for them. Such an ingenious person was Count Rumford;¹⁸ and he and his successors have

¹⁸ Benjamin Thompson, Count Rumford (1753-1814), an American by birth, was an adventurer, a scientist, and an inventor of a practical turn of mind. He boasted, among other things, of having cured five hundred London chimneys of smoking.

landed us in the theory of the persistence, or indestructibility, of force. And in the infinitely minute, as in the infinitely great, the seekers after natural knowledge of the kinds called physical and chemical, have everywhere found a definite order and succession of events which seem never to be infringed.

And how has it fared with "Physick" and Anatomy? Have the anatomist, the physiologist, or the physician, whose business it has been to devote themselves assiduously to that eminently practical and direct end, the alleviation of the sufferings of mankind, — have they been able to confine their vision more absolutely to the strictly useful? I fear they are worst offenders of all. For if the astronomer has set before us the infinite magnitude of space, and the practical eternity of the duration of the universe; if the physical and chemical philosophers have demonstrated the infinite minuteness of its constituent parts, and the practical eternity of matter and of force; and if both have alike proclaimed the universality of a definite and predicable order and succession of events, the workers in biology have not only accepted all these, but have added more startling theses of their own. For, as these astronomers discover in the earth no center of the universe, but an eccentric speck, so the naturalists find man to be no center of the living world, but one amidst endless modifications of life; and as the astronomer observes the mark of practically endless time set upon the arrangements of the solar system so the student of life finds the records of ancient forms of existence peopling the world for ages, which, in relation to human experience, are infinite.

Furthermore, the physiologist finds life to be as dependent for its manifestation on particular molecular arrangements as any physical or chemical phenomenon; and wherever he extends his researches, fixed order and

unchanging causation reveal themselves, as plainly as in the rest of Nature.

Nor can I find that any other fate has awaited the germ of Religion. Arising, like all other kinds of knowledge, out of the action and interaction of man's mind, with that which is not man's mind, it has taken the intellectual coverings of Fetishism or Polytheism; of Theism or Atheism; of Superstition or Rationalism. With these, and their relative merits and demerits, I have nothing to do; but this it is needful for my purpose to say, that if the religion of the present differs from that of the past, it is because the theology of the present has become more scientific than that of the past; because it has not only renounced idols of wood and idols of stone, but begins to see the necessity of breaking in pieces the idols built up of books and traditions and fine-spun ecclesiastical cobwebs: and of cherishing the noblest and most human of man's emotions, by worship "for the most part of the silent sort" at the altar of the Unknown.

Such are a few of the new conceptions implanted in our minds by the improvement of natural knowledge. Men have acquired the ideas of the practically infinite extent of the universe and of its practical eternity; they are familiar with the conception that our earth is but an infinitesimal fragment of that part of the universe which can be seen; and that, nevertheless, its duration is, as compared with our standards of time, infinite. They have further acquired the idea that man is but one of innumerable forms of life now existing in the globe, and that the present existences are but the last of an immeasurable series of predecessors. Moreover, every step they have made in natural knowledge has tended to extend and rivet in their minds the conception of a definite order of the universe — which is em-

bodied in what are called, by an unhappy metaphor, the laws of Nature — and to narrow the range and loosen the force of men's belief in spontaneity, or in changes other than such as arise out of that definite order itself.

Whether these ideas are well or ill founded is not the question. No one can deny that they exist, and have been the inevitable outgrowth of the improvement of natural knowledge. And if so, it cannot be doubted that they are changing the form of men's most cherished and most important convictions.

x | And as regards the second point — the extent to which the improvement of natural knowledge has remodelled and altered what may be termed the intellectual ethics of men, — what are among the moral convictions most fondly held by barbarous and semi-barbarous people?

They are the convictions that authority is the soundest basis of belief; that merit attaches to a readiness to believe; that the doubting disposition is a bad one, and scepticism a sin; that when good authority has pronounced what is to be believed, and faith has accepted it, reason has no further duty. There are many excellent persons who yet hold by these principles, and it is not my present business, or intention, to discuss their views. All I wish to bring clearly before your minds is the unquestionable fact, that the improvement of natural knowledge is effected by methods which directly give the lie to all these convictions, and assume the exact reverse of each to be true.

x x | The improver of natural knowledge absolutely refuses to acknowledge authority, as such. For him, scepticism¹⁹

¹⁹ It is scarcely necessary to point out that Huxley is not here talking about scepticism in religion, but only about the habit of doubt that leads to truth. The "golden rule" which should guide one in this skepticism Huxley stated thus in his

is the highest of duties; blind faith the one unpardonable sin. And it cannot be otherwise, for every great advance in natural knowledge has involved the absolute rejection of authority, the cherishing of the keenest scepticism, the annihilation of the spirit of blind faith; and the most ardent votary of science holds his firmest convictions, not because the men he most venerates hold

address *On Descartes' Discourse on Method* (1870): "Give unqualified assent to no propositions but those the truth of which is so clear and distinct that it cannot be doubted." And later he defined the scientific doubt thus: "When I say that Descartes consecrated doubt, you must remember that it was that sort of doubt which Goethe has called the active scepticism whose whole aim is to conquer itself; and not that other sort which is born of flippancy and ignorance, and whose aim is only to perpetuate itself, as an excuse for idleness and indifference. But it is impossible to define what is meant by scientific doubt better than in Descartes' own words. After describing the gradual progress of his negative criticism, he tells us:—

"For all that, I did not imitate the sceptics, who doubt only for doubting's sake, and pretend to be always undecided; on the contrary, my whole intention was to arrive at a certainty, and to dig away the drift and the sand until I reached the rock or the clay beneath."—*Methods and Results, Collected Essays*, I:169.

In the conclusion of the lay sermon, *On the Physical Basis of Life*, 1868, Huxley had pointed that on subjects concerning which we can know nothing certainly it is useless to speculate, and then stated in a fine passage what he considered the duty of man to be: "We live in a world which is full of misery and ignorance, and the plain duty of each and all of us is to try to make the little corner he can influence somewhat less miserable and somewhat less ignorant than it was before he entered it. To do this effectually it is necessary to be fully possessed of only two beliefs: the first, that the order of Nature is ascertainable by our faculties to an extent which is practically unlimited; the second, that our volition* counts for something as a condition of the course of events.

"Each of these beliefs can be verified experimentally, as often as we like to try. Each, therefore, stands upon the strongest foundation upon which any belief can rest, and forms one of our highest truths."

* Or, to speak more accurately, the physical state of which volition is the expression.— [1892. T. H. H.] *Same*, 163.

them; not because their verity is testified by portents and wonders; but because his experience teaches him that whenever he chooses to bring these convictions into contact with their primary source, Nature — whenever he thinks fit to test them by appealing to experiment and to observation — Nature will confirm them. The man of science has learned to believe in justification, not by faith, but by verification.

Thus, without for a moment pretending to despise the practical results of the improvement of natural knowledge, and its beneficial influence on material civilization, it must, I think, be admitted that the great ideas, some of which I have indicated, and the ethical spirit which I have endeavoured to sketch, in the few moments which remained at my disposal, constitute the real and permanent significance of natural knowledge.

If these ideas be destined, as I believe they are, to be more and more firmly established as the world grows older; if that spirit be fated, as I believe it is, to extend itself into all departments of human thought, and to become co-extensive with the range of knowledge; if, as our race approaches its maturity, it discovers, as I believe it will, that there is but one kind of knowledge and but one method of acquiring it; then we, who are still children, may justly feel it our highest duty to recognize the advisableness of improving natural knowledge, and so to aid ourselves and our successors in their course towards the noble goal which lies before mankind.

THE METHOD OF SCIENTIFIC INVESTIGATION ¹

PHYSICAL science is one and indivisible. Although, for practical purposes, it is convenient to mark it out into the primary regions of Physics, Chemistry, and Biology, and to subdivide these into subordinate provinces, yet the method of investigation and the ultimate object of the physical inquirer are everywhere the same.

The object is the discovery of the rational order which pervades the universe; the method consists of observation and experiment (which is observation under artificial conditions) for the determination of the facts of Nature; of inductive and deductive reasoning for the discovery of their mutual relations and connection. The various branches of physical science differ in the extent to which, at any given moment of their history, observation on the one hand, or ratiocination on the other, is their more obvious feature, but in no other way; and nothing can be more incorrect than the assumption one sometimes meets with, that physics has one method, chemistry another, and biology a third.

All physical science starts from certain postulates. One of them is the objective existence of a material world. It is assumed that the phenomena which are

¹ This extract is taken from an essay, *The Progress of Science*, written in 1887 for *The Reign of Queen Victoria*, by T. H. Ward. The essay is published in *Methods and Results, Collected Essays*, I.

comprehended under this name have a "substratum" of extended, impenetrable, mobile substance, which exhibits the quality known as inertia, and is termed matter.² Another postulate is the universality of the law of causation; that nothing happens without a cause (that is, a necessary precedent condition), and that the state of the physical universe, at any given moment, is the consequence of its state at any preceding moment. Another is that any of the rules, or so-called "laws of Nature," by which the relation of phenomena is truly defined, is true for all time. The validity of these postulates is a problem of metaphysics; they are neither self-evident nor are they, strictly speaking, demonstrable. The justification of their employment, as axioms of physical philosophy, lies in the circumstance that expectations logically based upon them are verified, or, at any rate, not contradicted, whenever they can be tested by experience.

Physical science therefore rests on verified or uncontradicted hypotheses; and, such being the case, it is not surprising that a great condition of its progress has been the invention of verifiable hypotheses. It is a favourite popu-

² I am aware that this proposition may be challenged. It may be said, for example, that, on the hypothesis of Boscovich, matter has no extension, being reduced to mathematical points serving as centres of "forces." But as the "forces" of the various centres are conceived to limit one another's action in such a manner that an area around each centre has an individuality of its own, extension comes back in the form of that area. Again, a very eminent mathematician and physicist—the late Clerk Maxwell—has declared that impenetrability is not essential to our notions of matter, and that two atoms may conceivably occupy the same space. I am loth to dispute any dictum of a philosopher as remarkable for the subtlety of his intellect as for his vast knowledge; but the assertion that one and the same point or area of space can have different (conceivably opposite) attributes appears to me to violate the principle of contradiction, which is the foundation not only of physical science, but of logic in general. It means that A can be not-A. [T. H. H.]

lar delusion that the scientific inquirer is under a sort of moral obligation to abstain from going beyond that generalisation of observed facts which is absurdly called "Baconian" induction.³ But any one who is practically acquainted with scientific work is aware that those who refuse to go beyond fact, rarely get as far as fact; and any one who has studied the history of science knows that almost every great step therein has been made by the "anticipation of Nature," that is, by the invention of hypotheses, which, though verifiable, often had very little foundation to start with; and, not unfrequently, in spite of a long career of usefulness, turned out to be wholly erroneous in the long run.

The geocentric system of astronomy, with its eccentrics and its epicycles, was an hypothesis utterly at variance with fact, which nevertheless did great things for the advancement of astronomical knowledge. Kepler⁴ was the wildest of guessers. Newton's corpuscular theory of light was of much temporary use in optics, though nobody now believes in it; and the undulatory theory, which has superseded the corpuscular theory and has proved one of the most fertile of instruments of research, is based on the hypothesis of the existence of an "ether," the properties of which are defined in propositions, some of which, to ordinary apprehension, seem physical antinomies.

It sounds paradoxical to say that the attainment of scientific truth has been effected, to a great extent, by the help of scientific errors. But the subject-matter of physical science is furnished by observation, which can-

³ See p. 19, n.

⁴ Johan Kepler (1571-1630), a German astronomer, devoted years to the observation of the orbit of Mars, with the result that he announced in his *Astronomia*, 1609, the laws of elliptical orbits, "one of the cardinal principles of modern astronomy," and other important discoveries.

not extend beyond the limits of our faculties; while, even within those limits, we cannot be certain that any observation is absolutely exact and exhaustive. Hence it follows that any given generalisation from observation may be true, within the limits of our powers of observation at a given time, and yet turn out to be untrue, when those powers of observation are directly or indirectly enlarged. Or, to put the matter in another way, a doctrine which is untrue absolutely, may, to a very great extent, be susceptible of an interpretation in accordance with the truth. At a certain period in the history of astronomical science, the assumption that the planets move in circles was true enough to serve the purpose of correlating such observations as were then possible; after Kepler, the assumption that they move in ellipses became true enough in regard to the state of observational astronomy at that time. We say still that the orbits of the planets are ellipses, because, for all ordinary purposes, that is a sufficiently near approximation to the truth; but, as a matter of fact, the center of gravity of a planet describes neither an ellipse nor any other simple curve, but an immensely complicated undulating line. It may fairly be doubted whether any generalisation, or hypothesis, based upon physical data is absolutely true, in the sense that a mathematical proposition is so; but, if its errors can become apparent only outside the limits of practicable observation, it may be just as usefully adopted for one of the symbols of that algebra by which we interpret Nature, as if it were absolutely true.

The development of every branch of physical knowledge presents three stages, which, in their logical relation, are successive. The first is the determination of the sensible character and order of the phenomena. This is *Natural History*, in the original sense of the term, and

here nothing but observation and experiment avail us. The second is the determination of the constant relations of the phenomena thus defined, and their expression in rules or laws. The third is the explication of these particular laws by deduction from the most general laws of matter and motion. The last two stages constitute *Natural Philosophy* in its original sense. In this region, the invention of verifiable hypotheses is not only permissible, but it is one of the conditions of progress.

Historically, no branch of science has followed this order of growth; but, from the dawn of exact knowledge to the present day, observation, experiment, and speculation have gone hand in hand; and, whenever science has halted or strayed from the right path, it has been, either because its votaries have been content with mere unverified or unverifiable speculation (and this is the commonest case, because observation and experiment are hard work, while speculation is amusing); or it has been, because the accumulation of details of observation has for a time excluded speculation.

The progress of physical science, since the revival of learning, is largely due to the fact that men have gradually learned to lay aside the consideration of unverifiable hypotheses; to guide observation and experiment by verifiable hypotheses; and to consider the latter, not as ideal truths, the real entities of an intelligible world behind phenomena, but as a symbolical language, by the aid of which Nature can be interpreted in terms apprehensible by our intellects. And if physical science, during the last fifty years, has attained dimensions beyond all former precedent, and can exhibit achievements of greater importance than any former such period can show, it is because able men, animated by the true scientific spirit, carefully trained in the method of science,

and having at their disposal immensely improved appliances, have devoted themselves to the enlargement of the boundaries of natural knowledge in greater number than during any previous half-century of the world's history.

PROLEGOMENA ¹

I

IT may be safely assumed that, two thousand years ago, before Cæsar set foot in southern Britain, the whole country-side visible from the windows of the room in which I write, was in what is called "the state of nature." Except, it may be, by raising a few sepulchral mounds, such as those which still, here and there, break the flowing contours of the downs, man's hands had

¹ *Prolegomena* was written in 1894 when Huxley, preparing to publish his *Evolution and Ethics*, found it necessary to supply a preface explaining some ideas which he had taken for generally accepted, particularly what he considered the conflict between the laws of society and of ethics and the laws of nature. Although Huxley was extraordinarily successful in rendering new ideas intelligible to popular audiences, the discourse on *Evolution and Ethics* is pretty difficult, and Huxley admitted his error and repaired it by one of his finest essays. He says in the preface that he had forgotten a "maxim touching lectures of a popular character, which has descended to me from that prince of lecturers, Mr. Faraday. He was once asked by a beginner, called upon to address a highly select and cultivated audience, what he might suppose his hearers to know already. Whereupon the past master of the art of exposition emphatically replied, 'Nothing!'

"To my shame as a retired veteran, who has all his life profited by this great precept of lecturing strategy, I forgot all about it just when it would have been most useful. I was fatuous enough to imagine that a number of propositions, which I thought established, and which, in fact, I had advanced without challenge on former occasions, needed no repetition.

"I have endeavoured to repair my error by prefacing the lecture with some matter—chiefly elementary or recapitulatory—to which I have given the title of 'Prolegomena.' I wish I could

made no mark upon it; and the thin veil of vegetation which overspread the broad-backed heights and the shelving sides of the coombs was unaffected by his industry. The native grasses and weeds, the scattered patches of gorse, contended with one another for the possession of the scanty surface soil; they fought against the droughts of summer, the frosts of winter, and the furious gales which swept, with unbroken force, now from the Atlantic, and now from the North Sea, at all times of the year; they filled up, as they best might, the gaps made in their ranks by all sorts of underground and overground animal ravagers. One year with another, an average population, the floating balance of the unceasing struggle for existence among the indigenous plants, maintained itself. It is as little to be doubted, that an essentially similar state of nature prevailed, in this region, for many thousand years before the coming of Cæsar; and there is no assignable reason for denying that it might continue to exist through an equally prolonged futurity, except for the intervention of man.

Reckoned by our customary standards of duration, the native vegetation, like the "everlasting hills" which it clothes, seems a type of permanence. The little Amarella Gentians, which abound in some places today, are the descendants of those that were trodden underfoot by the prehistoric savages who have left their flint tools about, here and there; and they followed an-

have hit upon a heading of less pedantic aspect which would have served my purpose; and if it be urged that the new building looks over large for the edifice to which it is added, I can only plead the precedent of the ancient architects, who always made the adytum the smallest part of the temple." — Preface, vii-viii.

In the discourse on the *Struggle for Existence in Human Society* he discussed one aspect of the same subject, how the struggle for existence, which is a law of nature, injects itself after all into human society and threatens to destroy the social order. See next essay.

cestors which, in the climate of the glacial epoch, probably flourished better than they do now. Compared with the long past of this humble plant, all the history of civilized men is but an episode.

Yet nothing is more certain than that, measured by the liberal scale of time-keeping of the universe, this present state of nature, however it may seem to have gone and to go on for ever, is but a fleeting phase of her infinite variety; merely the last of the series of changes which the earth's surface has undergone in the course of the millions of years of its existence. Turn back a square foot of the thin turf, and the solid foundation of the land, exposed in cliffs of chalk five hundred feet high on the adjacent shore, yields full assurance of a time when the sea covered the site of the "everlasting hills"; and when the vegetation of what land lay nearest, was as different from the present Flora of the Sussex downs, as that of Central Africa now is.² No less certain is it that, between the time during which the chalk was formed and that at which the original turf came into existence, thousands of centuries elapsed, in the course of which, the state of nature of the ages during which the chalk was deposited, passed into that which now is, by changes so slow that, in the coming and going of the generations of men, had such witnessed them, the contemporary conditions would have seemed to be unchanging and unchangeable.

But it is also certain that, before the deposition of the chalk, a vastly longer period had elapsed, throughout which it is easy to follow the traces of the same process of ceaseless modification and of the internecine struggle for existence of living things; and that even when we can get no further back, it is not because there is any reason to think we have reached the beginning,

² See "On a Piece of Chalk," *Essays*, viii:1. [T. H. H.]

but because the trail of the most ancient life remains hidden, or has become obliterated.

Thus that state of nature of the world of plants which we began by considering, is far from possessing the attribute of permanence. Rather its very essence is impermanence. It may have lasted twenty or thirty thousand years, it may last for twenty or thirty thousand years more, without obvious change; but, as surely as it has followed upon a very different state, so it will be followed by an equally different condition. That which endures is not one or another association of living forms, but the process of which the cosmos is the product, and of which these are among the transitory expressions. And in the living world, one of the most characteristic features of this cosmic process is the struggle for existence, the competition of each with all, the result of which is the selection, that is to say, the survival of those forms which, on the whole, are best adapted to the conditions which at any period obtain; and which are, therefore, in that respect, and only in that respect, the fittest.³ The acme reached by the cosmic process in the vegetation of the downs is seen in the turf, with its weeds and gorse. Under the conditions, they have come out of the struggle victorious; and, by surviving, have proved that they are the fittest to survive.

That the state of nature, at any time, is a temporary phase of a process of incessant change, which has been

³ That every theory of evolution must be consistent not merely with progressive development, but with indefinite persistence in the same condition and with retrogressive modification, is a point which I have insisted upon repeatedly from the year 1862 till now. See *Collected Essays*, vol. ii. pp. 461-89; vol. iii. p. 33; vol. viii, p. 304. In the address on "Geological Contemporaneity and Persistent Types" (1862), the paleontological proofs of this proposition were, I believe, first set forth. [T. H. H.]

going on for innumerable ages, appears to me to be a proposition as well established as any in modern history. Paleontology assures us, in addition, that the ancient philosophers who, with less reason, held the same doctrine, erred in supposing that the phases formed a cycle, exactly repeating the past, exactly foreshadowing the future, in their rotations. On the contrary, it furnishes us with conclusive reasons for thinking that, if every link in the ancestry of these humble indigenous plants had been preserved and were accessible to us, the whole would present a converging series of forms of gradually diminishing complexity, until, at some period in the history of the earth, far more remote than any of which organic remains have yet been discovered, they would merge in those low groups among which the boundaries between animal and vegetable life become effaced.⁴

The word "evolution," now generally applied to the cosmic process, has had a singular history, and is used in various senses.⁵ Taken in its popular signification it means progressive development, that is, gradual change from a condition of relative uniformity to one of relative complexity; but its connotation has been widened to include the phenomena of retrogressive metamorphosis, that is, of progress from a condition of relative complexity to one of relative uniformity.

As a natural process, of the same character as the development of a tree from its seed, or of a fowl from its egg, evolution excludes creation and all other kinds of supernatural intervention. As the expression of a fixed order, every stage of which is the effect of causes operating according to definite rules, the conception of evolution no less excludes that of chance. It is very desirable

⁴ "On the Border Territory between the Animal and the Vegetable Kingdoms," *Essays*, vol. viii. p. 162. [T. H. H.]

⁵ See "Evolution in Biology," *Essays*, vol. ii. p. 187. [T. H. H.]

to remember that evolution is not an explanation of the cosmic process, but merely a generalised statement of the method and results of that process. And, further, that, if there is proof that the cosmic process was set going by any agent, then that agent will be the creator of it and of all its products, although supernatural intervention may remain strictly excluded from its further course.

So far as that limited revelation of the nature of things, which we call scientific knowledge, has yet gone, it tends, with constantly increasing emphasis, to the belief that, not merely the world of plants, but that of animals; not merely living things, but the whole fabric of the earth; not merely our planet, but the whole solar system; not merely our star and its satellites, but the millions of similar bodies which bear witness to the order which pervades boundless space, and has endured through boundless time; are all working out their predestined courses of evolution.

With none of these have I anything to do, at present, except with that exhibited by the forms of life which tenant the earth. All plants and animals exhibit the tendency to vary, the causes of which have yet to be ascertained; it is the tendency of the conditions of life, at any given time, while favouring the existence of the variations best adapted to them, to oppose that of the rest and thus to exercise selection; and all living things tend to multiply without limit, while the means of support are limited; the obvious cause of which is the production of offspring more numerous than their progenitors, but with equal expectation of life in the actuarial sense. Without the first tendency there could be no evolution. Without the second, there would be no good reason why one variation should disappear and another take its place; that is to say there would be no selection.

Without the third, the struggle for existence, the agent of the selective process in the state of nature, would vanish.⁶

Granting the existence of these tendencies, all the known facts of the history of plants and of animals may be brought into rational correlation. And this is more than can be said for any other hypothesis that I know of. Such hypotheses, for example, as that of the existence of a primitive, orderless chaos; of a passive and sluggish eternal matter moulded, with but partial success, by archetypal ideas; of a brand-new world-stuff suddenly created and swiftly shaped by a supernatural power; receive no encouragement, but the contrary, from our present knowledge. That our earth may once have formed part of a nebulous cosmic magma is certainly possible, indeed seems highly probable; but there is no reason to doubt that order reigned there, as completely as amidst what we regard as the most finished works of nature or of man.⁷ The faith which is born of knowledge, finds its object in an eternal order, bringing forth ceaseless change, through endless time, in endless space; the manifestations of the cosmic energy alternating between phases of potentiality and phases of explication. It may be that, as Kant suggests,⁸ every cosmic magma predestined to evolve into a new world, has been the no less predestined end of a vanished predecessor.

II.

Three or four years have elapsed since the state of nature, to which I have referred, was brought to an end, so far as a small patch of the soil is concerned, by the intervention of man. The patch was cut off

⁶ *Collected Essays*, vol. ii. *passim*. [T. H. H.]

⁷ *Ibid.*, vol. iv. p. 138; vol. v. pp. 71-73. [T. H. H.]

⁸ *Ibid.*, vol. viii. p. 321. [T. H. H.]

from the rest by a wall; within the area thus protected, the native vegetation was, as far as possible, extirpated; while a colony of strange plants was imported and set down in its place. In short, it was made into a garden. At the present time, this artificially treated area presents an aspect extraordinarily different from that of so much of the land as remains in the state of nature, outside the wall. Trees, shrubs, and herbs, many of them appertaining to the state of nature of remote parts of the globe, abound and flourish. Moreover, considerable quantities of vegetables, fruits, and flowers are produced, of kinds which neither now exist, nor have ever existed, except under conditions such as obtain in the garden; and which, therefore, are as much works of the art of man as the frames and glass-houses in which some of them are raised. That the "state of Art," thus created in the state of nature by man, is sustained by and dependent on him, would at once become apparent, if the watchful supervision of the gardener were withdrawn, and the antagonistic influences of the general cosmic process were no longer sedulously warded off, or counteracted. The walls and gates would decay; quadrupedal and bipedal intruders would devour and tread down the useful and beautiful plants; birds, insects, blight, and mildew would work their will; the seeds of the native plants, carried by winds or other agencies, would immigrate, and in virtue of their long-earned special adaptation to the local conditions, these despised native weeds would soon choke their choice exotic rivals. A century or two hence, little beyond the foundations of the wall and of the houses and frames would be left, in evidence of the victory of the cosmic powers at work in the state of nature, over the temporary obstacles to their supremacy, set up by the art of the horticulturist.

It will be admitted that the garden is as much a work of art,⁹ or artifice, as anything that can be mentioned. The energy localised in certain human bodies, directed by similarly localised intellects, has produced a collocation of other material bodies which could not be brought about in the state of nature. The same proposition is true of all the works of man's hands, from a flint implement to a cathedral or a chronometer; and it is because it is true, that we call these things artificial, term them works of art, or artifice, by way of distinguishing them from the products of the cosmic process, working outside man, which we call natural, or works of nature. The distinction thus drawn between the works of nature and those of man, is universally recognized; and it is, as I conceive, both useful and justifiable.

III.

No doubt, it may be properly urged that the operation of human energy and intelligence, which has brought into existence and maintains the garden, by what I have called "the horticultural process," is, strictly speaking, part and parcel of the cosmic process. And no one could more readily agree to that proposition than I. In fact, I do not know that any one has taken more pains than I have, during the last thirty years, to insist upon the doctrine, so much reviled in the early part of that period, that man, physical, intellectual, and

⁹ The sense of the term "Art" is becoming narrowed; "work of Art" to most people means a picture, a statue, or a piece of *bijouterie*; by way of compensation "artist" has included in its wide embrace cooks and ballet girls, no less than painters and sculptors. [T. H. H.]

moral, is as much a part of nature, as purely a product of the cosmic process, as the humblest weed.¹⁰

But if, following up this admission, it is urged that, such being the case, the cosmic process cannot be in antagonism with that horticultural process which is part of itself — I can only reply, that if the conclusion that the two are antagonistic is logically absurd, I am sorry for logic, because, as we have seen, the fact is so.¹¹ The garden is in the same position as every other work of man's art; it is a result of the cosmic process working through and by human energy and intelligence; and, as is the case with every other artificial thing set up in the state of nature, the influences of the latter are constantly tending to break it down and destroy it. No doubt, the Forth bridge¹² and an ironclad in the offing, are, in ultimate resort, products of the cosmic process; as much so as the river which flows under the one, or the sea-water on which the other floats. Nevertheless, every breeze strains the bridge a little, every tide does something to weaken its foundations; every change of temperature alters the adjustment of its parts, produces friction and consequent wear and tear. From time to time, the bridge must be repaired, just as the ironclad must go into dock; simply because nature is always tending to reclaim that which her child, man, has borrowed from her and has arranged in combinations which are not those favoured by the general cosmic process.

Thus, it is not only true that the cosmic energy, working through man upon a portion of the plant world,

¹⁰ See "Man's Place in Nature," *Collected Essays*, vol. vii., and "On the Struggle for Existence in Human Society" (1888), vol. ix. [T. H. H.]

¹¹ See *The Method of Scientific Investigation*.

¹² Forth bridge is a remarkable railway bridge over a mile and a half long crossing the Firth of Forth. It is built on the cantilever principle, and was completed in 1889.

opposes the same energy as it works through the state of nature, but a similar antagonism is everywhere manifest between the artificial and the natural. Even in the state of nature itself, what is the struggle for existence but the antagonism of the results of the cosmic process in the region of life, one to another?¹³

IV.

Not only is the state of nature hostile to the state of art of the garden; but the principle of the horticultural process, by which the latter is created and maintained, is antithetic to that of the cosmic process. The characteristic feature of the latter is the intense and unceasing competition of the struggle for existence. The characteristic of the former is the elimination of that struggle, by the removal of the conditions which give rise to it. The tendency of the cosmic process is to bring about the adjustment of the forms of plant life to the current conditions; the tendency of the horticultural process is the adjustment of the conditions to the needs of the forms of plant life which the gardener desires to raise.

The cosmic process uses unrestricted multiplication as the means whereby hundreds compete for the place and nourishment adequate for one; it employs frost and drought to cut off the weak and unfortunate; to survive, there is need not only of strength, but of flexibility and of good fortune.

The gardener, on the other hand, restricts multiplication; provides that each plant shall have sufficient space

¹³ Or to put the case still more simply. When a man lays hold of the two ends of a piece of string and pulls them, with intent to break it, the right arm is certainly exerted in antagonism to the left arm; yet both arms derive their energy from the same original source. [T. H. H.]

and nourishment; protects from frost and drought; and, in every other way, attempts to modify the conditions, in such a manner as to bring about the survival of those forms which most nearly approach the standard of the useful, or the beautiful, which he has in his mind.

If the fruits and the tubers, the foliage and the flowers thus obtained, reach, or sufficiently approach, that ideal, there is no reason why the *status quo* attained should not be indefinitely prolonged. So long as the state of nature remains approximately the same, so long will the energy and intelligence which created the garden suffice to maintain it. However, the limits within which this mastery of man over nature can be maintained are narrow. If the conditions of the cretaceous epoch returned, I fear the most skilful of gardeners would have to give up the cultivation of apples and gooseberries; while, if those of the glacial period once again obtained, open asparagus beds would be superfluous, and the training of fruit trees against the most favourable of south walls, a waste of time and trouble.

But it is extremely important to note that, the state of nature remaining the same, if the produce does not satisfy the gardener, it may be made to approach his ideal more closely. Although the struggle for existence may be at end, the possibility of progress remains. In discussions on these topics, it is often strangely forgotten that the essential conditions of the modification, or evolution, of living things are variation and hereditary transmission. Selection is the means by which certain variations are favoured and their progeny preserved. But the struggle for existence is only one of the means by which selection may be effected. The endless varieties of cultivated flowers, fruits, roots, tubers, and bulbs are not products of selection by means of the struggle for existence, but of direct selection, in view

of an ideal of utility or beauty. Amidst a multitude of plants, occupying the same station and subjected to the same conditions, in the garden, varieties arise. The varieties tending in a given direction are preserved, and the rest are destroyed. And the same process takes place among the varieties until, for example, the wild kale becomes a cabbage, or the wild *Viola tricolor* a prize pansy.

v.

The process of colonisation presents analogies to the formation of a garden which are highly instructive. Suppose a shipload of English colonists sent to form a settlement, in such a country as Tasmania was in the middle of the last century. On landing, they find themselves in the midst of a state of nature, widely different from that left behind them in everything but the most general physical conditions. The common plants, the common birds and quadrupeds, are as totally distinct as the men from anything to be seen on the side of the globe from which they come. The colonists proceed to put an end to this state of things over as large an area as they desire to occupy. They clear away the native vegetation, extirpate or drive out the animal population, so far as may be necessary, and take measures to defend themselves from the re-immigration of either. In their place, they introduce English grain and fruit trees; English dogs, sheep, cattle, horses; and English men; in fact, they set up a new Flora and Fauna and a new variety of mankind, within the old state of nature. Their farms and pastures represent a garden on a great scale, and themselves the gardeners who have to keep it up, in watchful antagonism to the old *régime*. Con-

sidered as a whole, the colony is a composite unit introduced into the old state of nature; and, thenceforward, a competitor in the struggle for existence, to conquer or be vanquished.

Under the conditions supposed, there is no doubt of the result, if the work of the colonists be carried out energetically and with intelligent combination of all their forces. On the other hand, if they are slothful, stupid, and careless; or if they waste their energies in contests with one another, the chances are that the old state of nature will have the best of it. The native savage will destroy the immigrant civilized man; of the English animals and plants some will be extirpated by their indigenous rivals, others will pass into the feral state and themselves become components of the state of nature. In a few decades, all other traces of the settlement will have vanished.

VI.

Let us now imagine that some administrative authority, as far superior in power and intelligence to men, as men are to their cattle, is set over the colony, charged to deal with its human elements in such a manner as to assure the victory of the settlement over the antagonistic influences of the state of nature in which it is set down. He would proceed in the same fashion as that in which the gardener dealt with his garden. In the first place, he would, as far as possible, put a stop to the influence of external competition by thoroughly extirpating and excluding the native rivals, whether men, beasts, or plants. And our administrator would select his human agents, with a view to his ideal of a successful colony,

just as the gardener selects his plants with a view to his ideal of useful or beautiful products.

In the second place, in order that no struggle for the means of existence between these human agents should weaken the efficiency of the corporate whole in the battle with the state of nature, he would make arrangements by which each would be provided with those means; and would be relieved from the fear of being deprived of them by his stronger or more cunning fellows. Laws, sanctioned by the combined force of the colony, would restrain the self-assertion of each man within the limits required for the maintenance of peace. In other words, the cosmic struggle for existence, as between man and man, would be rigorously suppressed; and selection, by its means, would be as completely excluded as it is from the garden.

At the same time, the obstacles to the full development of the capacities of the colonists by other conditions of the state of nature than those already mentioned, would be removed by the creation of artificial conditions of existence of a more favourable character. Protection against extremes of heat and cold would be afforded by houses and clothing; drainage and irrigation works would antagonise the effects of excessive rain and excessive drought; roads, bridges, canals, carriages, and ships would overcome the natural obstacles to locomotion and transport; mechanical engines would supplement the natural strength of men and of their draught animals; hygienic precautions would check, or remove, the natural causes of disease. With every step of this progress in civilization, the colonists would become more and more independent of the state of nature; more and more, their lives would be conditioned by a state of art. In order to attain his ends, the administrator would have to avail himself of the courage, industry, and co-opera-

tive intelligence of the settlers; and it is plain that the interest of the community would be best served by increasing the proportion of persons who possess such qualities, and diminishing that of persons devoid of them. In other words, by selection directed towards an ideal.

Thus the administrator might look to the establishment of an earthly paradise, a true garden of Eden, in which all things should work together towards the well-being of the gardeners: within which the cosmic process, the coarse struggle for existence of the state of nature, should be abolished; in which that state should be replaced by a state of art; where every plant and every lower animal should be adapted to human wants, and would perish if human supervision and protection were withdrawn; where men themselves should have been selected, with a view to their efficiency as organs for the performance of the functions of a perfected society. And this ideal polity would have been brought about, not by gradually adjusting the men to the conditions around them, but by creating artificial conditions for them; not by allowing free play of the struggle for existence, but by excluding that struggle; and by substituting selection directed towards the administrator's ideal for the selection it exercises.

VII.

But the Eden would have its serpent, and a very subtle beast too. Man shares with the rest of the living world the mighty instinct of reproduction and its consequence, the tendency to multiply with great rapidity. The better the measures of the administrator

achieved their object, the more completely the destructive agencies of the state of nature were defeated, the less would that multiplication be checked.

On the other hand, within the colony, the enforcement of peace, which deprives every man of the power to take away the means of existence from another, simply because he is the stronger, would have put an end to the struggle for existence between the colonists, and the competition for the commodities of existence, which would alone remain, is no check upon population.

Thus, as soon as the colonists began to multiply, the administrator would have to face the tendency to the reintroduction of the cosmic struggle into his artificial fabric, in consequence of the competition, not merely for the commodities, but for the means of existence. When the colony reached the limit of possible expansion, the surplus population must be disposed of somehow; or the fierce struggle for existence must recommence and destroy that peace, which is the fundamental condition of the maintenance of the state of art against the state of nature.

Supposing the administrator to be guided by purely scientific considerations, he would, like the gardener, meet this most serious difficulty by systematic extirpation, or exclusion, of the superfluous. The hopelessly diseased, the infirm aged, the weak or deformed in body or in mind, the excess of infants born, would be put away, as the gardener pulls up defective and superfluous plants, or the breeder destroys undesirable cattle. Only the strong and the healthy, carefully matched, with a view to the progeny best adapted to the purposes of the administrator, would be permitted to perpetuate their kind.

VIII.

Of the more thoroughgoing of the multitudinous attempts to apply the principles of cosmic evolution, or what are supposed to be such, to social and political problems, which have appeared of late years, a considerable proportion appear to me to be based upon the notion that human society is competent to furnish, from its own resources, an administrator of the kind I have imagined. The pigeons, in short, are to be their own Sir John Sebright.¹⁴ A despotic government, whether individual or collective, is to be endowed with the preternatural intelligence, and with what, I am afraid, many will consider the preternatural ruthlessness, required for the purpose of carrying out the principle of improvement by selection, with the somewhat drastic thoroughness upon which the success of the method depends. Experience certainly does not justify us in limiting the ruthlessness of individual "saviours of society"; and, on the well-known grounds of the aphorism which denies both body and soul to corporations, it seems probable (indeed the belief is not without support in history) that a collective despotism, a mob got to believe in its own divine right by demagogic missionaries, would be capable of more thorough work in this direction than any single tyrant, puffed up with the same illusion, has ever achieved. But intelligence is another affair. The fact that "saviours of society" take to that trade is evidence enough that they have none to spare. And such as they possess is generally sold to the capi-

¹⁴ Not that the conception of such a society is necessarily based upon the idea of evolution. The Platonic state testifies to the contrary. [T. H. H.]

Sir John Sebright (1767-1846) published in 1809 a valuable letter on *The Art of Improving the Breeds of Domestic Animals*.

talists of physical force on whose resources they depend. However, I doubt whether even the keenest judge of character, if he had before him a hundred boys and girls under fourteen, could pick out, with the least chance of success, those who should be kept, as certain to be serviceable members of the polity, and those who should be chloroformed, as equally sure to be stupid, idle, or vicious. The "points" of a good or of a bad citizen are really far harder to discern than those of a puppy or a short-horn calf; many do not show themselves before the practical difficulties of life stimulate manhood to full exertion. And by that time the mischief is done. The evil stock, if it be one, has had time to multiply, and selection is nullified.

IX.

I have other reasons for fearing that this logical ideal of evolutionary regimentation — this pigeon-fanciers' polity — is unattainable. In the absence of any such a severely scientific administrator as we have been dreaming of, human society is kept together by bonds of such a singular character, that the attempt to perfect society after his fashion would run serious risk of loosening them.

Social organization is not peculiar to men. Other societies, such as those constituted by bees and ants, have also arisen out of the advantage of co-operation in the struggle for existence; and their resemblances to, and their differences from, human society are alike instructive. The society formed by the hive bee fulfils the ideal of the communistic aphorism "to each according to his needs, from each according to his capacity." Within it, the struggle for existence is strictly limited.

Queen, drones, and workers have each their allotted sufficiency of food; each performs the function assigned to it in the economy of the hive, and all contribute to the success of the whole coöperative society in its competition with rival collectors of nectar and pollen and with other enemies, in the state of nature without. In the same sense as the garden, or a colony, is a work of human art, the bee polity is a work of apiarian art, brought about by the cosmic process, working through the organization of the hymenopterous type.

Now this society is the direct product of an organic necessity, impelling every member of it to a course of action which tends to the good of the whole. Each bee has its duty and none has any rights. Whether bees are susceptible of feeling and capable of thought is a question which cannot be dogmatically answered. As a pious opinion, I am disposed to deny them more than the merest rudiments of consciousness.¹⁵ But it is curious to reflect that a thoughtful drone (workers and queens would have no leisure for speculation) with a turn for ethical philosophy, must needs profess himself an intuitive moralist of the purest water. He would point out, with perfect justice, that the devotion of the workers to a life of ceaseless toil for a mere subsistence wage, cannot be accounted for either by enlightened selfishness, or by any other sort of utilitarian motives; since these bees begin to work, without experience or reflection, as they emerge from the cell in which they are hatched. Plainly, an eternal and immutable principle, innate in each bee, can alone account for the phenomena. On the other hand, the biologist, who traces out all the extant stages of gradation between solitary and hive bees, as clearly

¹⁵ *Collected Essays*, vol. i., "Animal Automatism"; vol. v., "Prologue," pp. 45 *et seq.* [T. H. H.]

sees in the latter, simply the perfection of an automatic mechanism, hammered out by the blows of the struggle for existence upon the progeny of the former, during long ages of constant variation.

X.

I see no reason to doubt that, at its origin, human society was as much a product of organic necessity as that of the bees.¹⁶ The human family, to begin with, rested upon exactly the same conditions as those which gave rise to similar associations among animals lower in the scale. Further, it is easy to see that every increase in the duration of the family ties, with the resulting co-operation of a larger and larger number of descendants for protection and defence, would give the families in which such modification took place a distinct advantage over the others. And, as in the hive, the progressive limitation of the struggle for existence between the members of the family would involve increasing efficiency as regards outside competition.

But there is this vast and fundamental difference between bee society and human society. In the former, the members of the society are each organically predestined to the performance of one particular class of functions only. If they were endowed with desires, each could desire to perform none but those offices for which its organization specially fits it; and which, in view of the good of the whole, it is proper it should do. So long as a new queen does not make her appearance, rivalries and competition are absent from the bee polity.

Among mankind, on the contrary, there is no such predestination to a sharply defined place in the social

¹⁶ *Collected Essays*, vol. v., Prologue, pp. 50-54.

organism. However much men may differ in the quality of their intellects, the intensity of their passions, and the delicacy of their sensations, it cannot be said that one is fitted by his organization to be an agricultural labourer and nothing else, and another to be a landowner and nothing else. Moreover, with all their enormous differences in natural endowment, men agree in one thing, and that is their innate desire to enjoy the pleasures and to escape the pains of life; and, in short, to do nothing but that which it pleases them to do, without the least reference to the welfare of the society into which they are born. That is their inheritance (the reality at the bottom of the doctrine of original sin) from the long series of ancestors, human and semi-human and brutal, in whom the strength of this innate tendency to self-assertion was the condition of victory in the struggle for existence. That is the reason of the *aviditas vitæ*¹⁷ — the insatiable hunger for enjoyment — of all mankind, which is one of the essential conditions of success in the war with the state of nature outside; and yet the sure agent of the destruction of society if allowed free play within.

The check upon this free play of self-assertion, or natural liberty, which is the necessary condition for the origin of human society, is the product of organic necessities of a different kind from those upon which the constitution of the hive depends. One of these is the mutual affection of parent and offspring, intensified by the long infancy of the human species. But the most important is the tendency, so strongly developed in man, to reproduce in himself actions and feelings similar to, or correlated with, those of other men. Man is the most consummate of all mimics in the animal world; none but

¹⁷ " 'Thirst' or 'craving desire' for life." Note 7 to *Evolution and Ethics, Collected Essays*, IX:96.

himself can draw or model; none comes near him in the scope, variety, and exactness of vocal imitation; none is such a master of gesture; while he seems to be impelled thus to imitate for the pure pleasure of it. And there is no such another emotional chameleon. By a purely reflex operation of the mind, we take the hue of passion of those who are about us, or, it may be, the complementary colour. It is not by any conscious "putting one's self in the place" of a joyful or a suffering person that the state of mind we call sympathy usually arises;¹⁸ indeed, it is often contrary to one's sense of right, and in spite of one's will, that "fellow-feeling makes us wondrous kind," or the reverse. However complete may be the indifference to public opinion, in a cool, intellectual view, of the traditional sage, it has not yet been my fortune to meet with any actual sage who took its hostile manifestations with entire equanimity. Indeed, I doubt if the philosopher lives, or ever has lived, who could know himself to be heartily despised by a street boy without some irritation. And, though one cannot justify Haman for wishing to hang Mordecai on such a very high gibbet, yet, really, the consciousness of the Vizier of Ahasuerus, as he went in and out of the gate, that this obscure Jew had no respect for him, must have been very annoying.¹⁹

¹⁸ Adam Smith makes the pithy observation that the man who sympathises with a woman in childbed, cannot be said to put himself in her place. ("The Theory of the Moral Sentiments," Part vii. sec. iii. chap. i.) Perhaps there is more humour than force in the example; and, in spite of this and other observations of the same tenor, I think that the one defect of the remarkable work in which it occurs is that it lays too much stress on conscious substitution, too little on purely reflex sympathy. [T. H. H.]

¹⁹ Esther v. 9-13. ". . . but when Haman saw Mordecai in the king's gate, that he stood not up, nor moved for him, he was full of indignation against Mordecai. . . . And Haman told them of the glory of his riches . . . and all the things wherein

It is needful only to look around us, to see that the greatest restrainer of the anti-social tendencies of men is fear, not of the law, but of the opinion of their fellows. The conventions of honour bind men who break legal, moral, and religious bonds; and, while people endure the extremity of physical pain rather than part with life, shame drives the weakest to suicide.

Every forward step of social progress brings men into closer relations with their fellows, and increases the importance of the pleasures and pains derived from sympathy. We judge the acts of others by our own sympathies, and we judge our own acts by the sympathies of others, every day and all day long, from childhood upwards, until associations, as indissoluble as those of language, are formed between certain acts and the feelings of approbation or disapprobation. It becomes impossible to imagine some acts without disapprobation, or others without approbation of the actor, whether he be one's self, or any one else. We come to think in the acquired dialect of morals. An artificial personality, the "man within," as Adam Smith²⁰ calls conscience, is built up beside the natural personality. He is the watchman of society, charged to restrain the anti-social tendencies of the natural man within the limits required by social welfare.

the king had promoted him. . . . Yet all this availeth me nothing, so long as I see Mordecai the Jew sitting at the king's gate." What a shrewd exposure of human weakness it is! [T. H. H.]

²⁰ "Theory of the Moral Sentiments," Part iii. chap 3. *On the influence and authority of conscience.* [T. H. H.]

Adam Smith (1723-1790), the Scotch economist, published in 1759 his *Theory of Moral Sentiments*. He is best known as the author of the *Wealth of Nations* and the founder of the science of political economy.

XI.

I have termed this evolution of the feelings out of which the primitive bonds of human society are so largely forged, into the organized and personified sympathy we call conscience, the ethical process.²¹ So far as it tends to make any human society more efficient in the struggle for existence with the state of nature, or with other societies, it works in harmonious contrast with the cosmic process. But it is none the less true that, since law and morals are restraints upon the struggle for existence between men in society, the ethical process is in opposition to the principle of the cosmic process, and tends to the suppression of the qualities best fitted for success in that struggle.²²

It is further to be observed that, just as the self-assertion, necessary to the maintenance of society against the state of nature, will destroy that society if it is allowed free operation within; so the self-restraint, the essence of the ethical process, which is no less an essential condition of the existence of every polity, may, by excess, become ruinous to it.

Moralists of all ages and of all faiths, attending only to the relations of men towards one another in an ideal society, have agreed upon the "golden rule," "Do as

²¹ Worked out, in its essential features, chiefly by Hartley and Adam Smith, long before the modern doctrine of evolution was thought of. [T. H. H.]

David Hartley (1705-1757) was an influential ethical philosopher. In his *Observations on Man*, 1749, he set forth his doctrine of the gradual development of pure benevolence from the simpler passions.

²² See the essay "On the Struggle for Existence in Human Society," and *Collected Essays*, vol. i. p. 276, for Kant's recognition of these facts. [T. H. H.]

you would be done by." In other words, let sympathy be your guide; put yourself in the place of the man towards whom your action is directed; and do to him what you would like to have done to yourself under the circumstances. However much one may admire the generosity of such a rule of conduct; however confident one may be that average man may be thoroughly depended upon not to carry it out to its full logical consequences; it is nevertheless desirable to recognise the fact that these consequences are incompatible with the existence of a civil state, under any circumstances of this world which have obtained, or, so far as one can see, are likely to come to pass.

For I imagine there can be no doubt that the great desire of every wrongdoer is to escape from the painful consequences of his actions. If I put myself in the place of the man who has robbed me, I find that I am possessed by an exceeding desire not to be fined or imprisoned; if in that of the man who has smitten me on one cheek, I contemplate with satisfaction the absence of any worse result than the turning of the other cheek for like treatment. Strictly observed, the "golden rule" involves the negation of law by the refusal to put it in motion against law-breakers; and, as regards the external relations of a polity, it is the refusal to continue the struggle for existence. It can be obeyed, even partially, only under the protection of a society which repudiates it. Without such shelter, the followers of the "golden rule" may indulge in hopes of heaven, but they must reckon with the certainty that other people will be masters of the earth.

What would become of the garden if the gardener treated all the weeds and slugs and birds and trespassers as he would like to be treated, if he were in their place?

XII.

Under the preceding heads, I have endeavoured to represent in broad, but I hope faithful, outlines the essential features of the state of nature and of that cosmic process of which it is the outcome, so far as was needful for my argument; I have contrasted with the state of nature the state of art, produced by human intelligence and energy, as it is exemplified by a garden; and I have shown that the state of art, here and elsewhere, can be maintained only by the constant counteraction of the hostile influences of the state of nature. Further, I have pointed out that the "horticultural process," which thus sets itself against the "cosmic process" is opposed to the latter in principle, in so far as it tends to arrest the struggle for existence, by restraining the multiplication which is one of the chief causes of that struggle, and by creating artificial conditions of life, better adapted to the cultivated plants than are the conditions of the state of nature. And I have dwelt upon the fact that, though the progressive modification, which is the consequence of the struggle for existence in the state of nature, is at an end, such modification may still be effected by that selection, in view of an ideal of usefulness, or of pleasantness, to man, of which the state of nature knows nothing.

I have proceeded to show that a colony, set down in a country in the state of nature, presents close analogies with a garden; and I have indicated the course of action which an administrator, able and willing to carry out horticultural principles, would adopt, in order to secure the success of such a newly formed polity, supposing it to be capable of indefinite expansion. In the contrary case, I have shown that difficulties must arise; that the unlimited increase of the population over a limited area

must, sooner or later, reintroduce into the colony that struggle for the means of existence between the colonists, which it was the primary object of the administrator to exclude, insomuch as it is fatal to the mutual peace which is the prime condition of the union of men in society.

I have briefly described the nature of the only radical cure, known to me, for the disease which would thus threaten the existence of the colony; and, however regretfully, I have been obliged to admit that this rigorously scientific method of applying the principles of evolution to human society hardly comes within the region of practical politics; not for want of will on the part of a great many people; but because, for one reason, there is no hope that mere human beings will ever possess enough intelligence to select the fittest. And I have adduced other grounds for arriving at the same conclusion.

I have pointed out that human society took its rise in the organic necessities expressed by imitation and by the sympathetic emotions; and that, in the struggle for existence with the state of nature and with other societies, as part of it, those in which men were thus led to close co-operation had a great advantage.²³ But, since each man retained more or less of the faculties common to all the rest, and especially a full share of the desire for unlimited self-gratification, the struggle for existence within society could only be gradually eliminated. So long as any of it remained, society continued to be an imperfect instrument of the struggle for existence, and, consequently, was improvable by the selective influence of that struggle. Other things being alike, the tribe of savages in which order was best maintained; in which there was most security within the tribe and the

²³ *Collected Essays*, vol. v., Prologue, p. 52. [T. H. H.]

most loyal mutual support outside it, would be the survivors.

I have termed this gradual strengthening of the social bond, which, though it arrest the struggle for existence inside society, up to a certain point improves the chances of society, as a corporate whole, in the cosmic struggle — the ethical process. I have endeavoured to show that, when the ethical process has advanced so far as to secure every member of the society in the possession of the means of existence, the struggle for existence, as between man and man, within that society is, *ipso facto*, at an end. And, as it is undeniable that the most highly civilized societies have substantially reached this position, it follows that, so far as they are concerned, the struggle for existence can play no important part within them.²⁴ In other words, the kind of evolution which is brought about in the state of nature cannot take place.

I have further shown cause for the belief that direct selection, after the fashion of the horticulturist and the breeder, neither has played, nor can play, any important part in the evolution of society; apart from other reasons, because I do not see how such selection could be practised without a serious weakening, it may be the destruction, of the bonds which hold society together. It strikes me that men who are accustomed to contemplate the active or passive extirpation of the weak, the unfortunate, and the superfluous; who justify that conduct on the ground that it has the sanction of the cosmic process, and is the only way of ensuring the progress of the race; who, if they are consistent, must rank medicine among

²⁴ Whether the struggle for existence with the state of nature and with other societies, so far as they stand in the relation of the state of nature with it, exerts a selective influence upon modern society, and in what direction, are questions not easy to answer. The problem of the effect of military and industrial warfare upon those who wage it is very complicated. [T. H. H.]

the black arts and count the physician a mischievous preserver of the unfit; on whose matrimonial undertakings the principles of the stud have the chief influence; whose whole lives, therefore, are an education in the noble art of suppressing natural affection and sympathy, are not likely to have any large stock of these commodities left. But, without them, there is no conscience, nor any restraint on the conduct of men, except the calculation of self-interest, the balancing of certain present gratifications against doubtful future pains; and experience tells us how much that is worth. Every day, we see firm believers in the hell of the theologians commit acts by which, as they believe when cool, they risk eternal punishment; while they hold back from those which are opposed to the sympathies of their associates.

XIII.

That progressive modification of civilization which passes by the name of the "evolution of society," is, in fact, a process of an essentially different character, both from that which brings about the evolution of species, in the state of nature, and from that which gives rise to the evolution of varieties, in the state of art.

There can be no doubt that vast changes have taken place in English civilization since the reign of the Tudors. But I am not aware of a particle of evidence in favour of the conclusion that this evolutionary process has been accompanied by any modification of the physical, or the mental, characters of the men who have been the subjects of it. I have not met with any grounds for suspecting that the average Englishmen of today are sensibly different from those that Shakespeare knew and drew. We look into his magic mirror of the Elizabethan

age, and behold, nowise darkly, the presentment of ourselves.

During these three centuries, from the reign of Elizabeth to that of Victoria, the struggle for existence between man and man has been so largely restrained among the great mass of the population (except for one or two short intervals of civil war), that it can have had little, or no, selective operation. As to anything comparable to direct selection, it has been practised on so small a scale that it may also be neglected. The criminal law, in so far as by putting to death or by subjecting to long periods of imprisonment, those who infringe its provisions, prevents the propagation of hereditary criminal tendencies; and the poor-law, in so far as it separates married couples whose destitution arises from hereditary defects of character, are doubtless selective agents operating in favour of the non-criminal and the more effective members of society. But the proportion of the population which they influence is very small; and, generally, the hereditary criminal and the hereditary pauper have propagated their kind before the law affects them. In a large proportion of cases, crime and pauperism have nothing to do with heredity; but are the consequence, partly, of circumstances and, partly, of the possession of qualities, which, under different conditions of life, might have excited esteem and even admiration. It was a shrewd man of the world who, in discussing sewage problems, remarked that dirt is riches in the wrong place; and that sound aphorism has moral applications. The benevolence and open-handed generosity which adorn a rich man, may make a pauper of a poor one; the energy and courage to which the successful soldier owes his rise, the cool and daring subtlety to which the great financier owes his fortune, may very easily, under unfavourable conditions, lead their possessors

to the gallows, or to the hulks. Moreover, it is fairly probable that the children of a "failure" will receive from their other parent just that little modification of character which makes all the difference. I sometimes wonder whether people, who talk so freely about extirpating the unfit, ever dispassionately consider their own history. Surely, one must be very "fit," indeed, not to know of an occasion, or perhaps two, in one's life, when it would have been only too easy to qualify for a place among the "unfit."

In my belief the innate qualities, physical, intellectual, and moral, of our nation have remained substantially the same for the last four or five centuries. If the struggle for existence has affected us to any serious extent (and I doubt it) it has been, indirectly, through our military and industrial wars with other nations.

XIV.

What is often called the struggle for existence in society (I plead guilty to having used the term too loosely myself), is a contest, not for the means of existence, but for the means of enjoyment. Those who occupy the first places in this practical competitive examination are the rich and the influential; those who fail, more or less, occupy the lower places, down to the squalid obscurity of the pauper and the criminal. Upon the most liberal estimate, I suppose the former group will not amount to two per cent. of the population. I doubt if the latter exceeds another two per cent.; but let it be supposed, for the sake of argument, that it is as great as five per cent.²⁵

²⁵ Those who read the last Essay in this volume will not accuse me of wishing to attenuate the evil of the existence of this group, whether great or small. [T. H. H.]

The essay referred to is *Social Diseases and Worse Remedies*, which includes *The Struggle for Existence* and *Letters to the "Times" on the "Darkest England Scheme,"* a condemnation of the constitution of the Salvation Army.

As it is only in the latter group that any thing comparable to the struggle for existence in the state of nature can take place; as it is only among this twentieth of the whole people that numerous men, women, and children die of rapid or slow starvation, or of the diseases incidental to permanently bad conditions of life; and as there is nothing to prevent their multiplication before they are killed off, while, in spite of greater infant mortality, they increase faster than the rich; it seems clear that the struggle for existence in this class can have no appreciable selective influence upon the other 95 per cent. of the population.

What sort of a sheep breeder would he be who should content himself with picking out the worst fifty out of a thousand, leaving them on a barren common till the weakest starved, and then letting the survivors go back to mix with the rest? And the parallel is too favourable; since in a large number of cases, the actual poor and the convicted criminals are neither the weakest nor the worst.

In the struggle for the means of enjoyment, the qualities which insure success are energy, industry, intellectual capacity, tenacity of purpose, and, at least, as much sympathy as is necessary to make a man understand the feelings of his fellows. Were there none of those artificial arrangements by which fools and knaves are kept at the top of society instead of sinking to their natural place at the bottom,²⁶ the struggle for the means of enjoyment would ensure a constant circulation of the human units of the social compound, from the bottom to the top and from the top to the bottom. The survivors of the contest, those who continued to form the

²⁶ I have elsewhere lamented the absence from society of a machinery for facilitating the descent of incapacity. "Administrative Nihilism." *Collected Essays*, vol. i. p. 54. [T. H. H.]

great bulk of the polity, would not be those "fittest" who got to the very top, but the great body of the moderately "fit," whose numbers and superior propagative power, enable them always to swamp the exceptionally endowed minority.

I think it must be obvious to every one, that, whether we consider the internal or the external interests of society, it is desirable they should be in the hands of those who are endowed with the largest share of energy, of industry, of intellectual capacity, of tenacity of purpose, while they are not devoid of sympathetic humanity; and, in so far as the struggle for the means of enjoyment tends to place such men in possession of wealth and influence, it is a process which tends to the good of society. But the process, as we have seen, has no real resemblance to that which adapts living beings to current conditions in the state of nature; nor any to the artificial selection of the horticulturist.

xv.

To return, once more, to the parallel of horticulture. In the modern world, the gardening of men by themselves is practically restricted to the performance, not of selection, but of that other function of the gardener, the creation of conditions more favourable than those of the state of nature; to the end of facilitating the free expansion of the innate faculties of the citizen, so far as it is consistent with the general good. And the business of the moral and political philosopher appears to me to be the ascertainment, by the same method of observation, experiment, and ratiocination, as is practised in other kinds of scientific work, of the course of conduct which will best conduce to that end.

But, supposing this course of conduct to be scientifi-

cally determined and carefully followed out, it cannot put an end to the struggle for existence in the state of nature; and it will not so much as tend, in any way, to the adaptation of man to that state. Even should the whole human race be absorbed in one vast polity, within which "absolute political justice" reigns, the struggle for existence with the state of nature outside it, and the tendency to the return to the struggle within, in consequence of over-multiplication, will remain; and, unless men's inheritance from the ancestors who fought a good fight in the state of nature, their dose of original sin, is rooted out by some method at present unrevealed, at any rate to disbelievers in supernaturalism, every child born into the world will still bring with him the instinct of unlimited self-assertion. He will have to learn the lesson of self-restraint and renunciation. But the practice of self-restraint and renunciation is not happiness, though it may be something much better.

That man, as a "political animal," is susceptible of a vast amount of improvement, by education, by instruction, and by the application of his intelligence to the adaptation of the conditions of life to his higher needs, I entertain not the slightest doubt. But so long as he remains liable to error, intellectual or moral; so long as he is compelled to be perpetually on guard against the cosmic forces, whose ends are not his ends, without and within himself; so long as he is haunted by inexpugnable memories and hopeless aspirations; so long as the recognition of his intellectual limitations forces him to acknowledge his incapacity to penetrate the mystery of existence; the prospect of attaining untroubled happiness, or of a state which can, even remotely, deserve the title of perfection, appears to me to be as misleading an illusion as ever was dangled before the eyes of poor humanity. And there have been many of them.

. That which lies before the human race is a constant struggle to maintain and improve, in opposition to the State of Nature, the State of Art of an organized polity; in which, and by which, man may develop a worthy civilization, capable of maintaining and constantly improving itself, until the evolution of our globe shall have entered so far upon its downward course that the cosmic process resumes its sway; and, once more, the State of Nature prevails over the surface of our planet.

Note (see p. 30).—It seems the fashion nowadays to ignore Hartley; though, a century and a half ago, he not only laid the foundations but built up much of the superstructure of a true theory of the Evolution of the intellectual and moral faculties. He speaks of what I have termed the ethical process as “our Progress from Self-interest to Self-annihilation.” *Observations on Man* (1749), vol. ii. p. 281. [T. H. H.]

THE STRUGGLE FOR EXISTENCE IN HUMAN SOCIETY ¹

THE vast and varied procession of events, which we call Nature, affords a sublime spectacle and an inexhaustible wealth of attractive problems to the speculative observer. If we confine our attention to that aspect which engages the attention of the intellect, nature appears a beautiful and harmonious whole, the incarnation of a faultless logical process, from certain premises in the past to an inevitable conclusion in the future. But if it be regarded from a less elevated, though more human, point of view; if our moral sympathies are allowed

¹ This essay appeared in the *Nineteenth Century* for February, 1888, and was prefixed as an introductory essay to a pamphlet, *Social Diseases and Worse Remedies*, 1891. Huxley said that the purpose of the essay was to state the principles that in his opinion lay at the bottom of the "social question." "So far as Individualism and Regimental Socialism are concerned, this paper simply emphasizes and expands the opinions expressed in an address to the members of the Midland Institute, delivered seventeen years earlier, and still more fully developed in several essays published in the "Nineteenth Century" in 1889, which I hope, before long, to republish.

"The fundamental proposition which runs through the writings, which thus extend over a period of twenty years, is, that the common *a priori* doctrines and methods of reasoning about political and social questions are essentially vicious; and that argumentation on this basis leads, with equal force, to two contradictory and extremely mischievous systems, the one that of Anarchic Individualism, the other that of despotic or Regimental Socialism." *Evol. and Ethics*, 189-190. *Administrative, Nihilism* was the address to the members of the Midland Institute. The essays from the *Nineteenth Century* referred to were published in *Collected Essays* I:290-430 and IX:147-187.

to influence our judgment, and we permit ourselves to criticise our great mother as we criticise one another; then our verdict, at least so far as sentient nature is concerned, can hardly be so favourable.

In sober truth, to those who have made a study of the phenomena of life as they are exhibited by the higher forms of the animal world, the optimistic dogma, that this is the best of all possible worlds, will seem little better than a libel upon possibility. It is really only another instance to be added to the many extant, of the audacity of *a priori* speculators who, having created God in their own image, find no difficulty in assuming that the Almighty must have been actuated by the same motives as themselves. They are quite sure that, had any other course been practicable, He would no more have made infinite suffering a necessary ingredient of His handiwork than a respectable philosopher would have done the like.

But even the modified optimism of the time-honoured thesis of physico-theology, that the sentient world is, on the whole, regulated by principles of benevolence, does but ill stand the test of impartial confrontation with the facts of the case. No doubt it is quite true that sentient nature affords hosts of examples of subtle contrivances directed towards the production of pleasure or the avoidance of pain; and it may be proper to say that these are evidences of benevolence. But if so, why is it not equally proper to say of the equally numerous arrangements, the no less necessary result of which is the production of pain, that they are evidences of malevolence?

If a vast amount of that which, in a piece of human workmanship, we should call skill, is visible in those parts of the organization of a deer to which it owes its ability to escape from beasts of prey, there is at least

equal skill displayed in that bodily mechanism of the wolf which enables him to track, and sooner or later to bring down, the deer. Viewed under the dry light of science, deer and wolf are alike admirable; and, if both were non-sentient automata, there would be nothing to qualify our admiration of the action of the one on the other. But the fact that the deer suffers, while the wolf inflicts suffering, engages our moral sympathies. We should call men like the deer innocent and good, men such as the wolf malignant and bad; we should call those who defended the deer and aided him to escape brave and compassionate, and those who helped the wolf in his bloody work base and cruel. Surely, if we transfer these judgments to nature outside the world of man at all, we must do so impartially. In that case, the goodness of the right hand which helps the deer, and the wickedness of the left hand which eggs on the wolf, will neutralize one another: and the course of nature will appear to be neither moral nor immoral, but non-moral.

This conclusion is thrust upon us by analogous facts in every part of the sentient world; yet, inasmuch as it not only jars upon prevalent prejudices, but arouses the natural dislike to that which is painful, much ingenuity has been exercised in devising an escape from it.

From the theological side, we are told that this is a state of probation, and that the seeming injustices and immoralities of nature will be compensated by and by. But how this compensation is to be effected, in the case of the great majority of sentient things, is not clear. I apprehend that no one is seriously prepared to maintain that the ghosts of all the myriads of generations of herbivorous animals which lived during the millions of years of the earth's duration, before the appearance of man, and which have all that time been tormented and devoured by carnivores, are to be compensated by a peren-

nial existence in clover; while the ghosts of carnivores are to go to some kennel where there is neither a pan of water nor a bone with any meat on it. Besides, from the point of view of morality, the last stage of things would be worse than the first. For the carnivores, however brutal and sanguinary, have only done that which, if there is any evidence of contrivance in the world, they were expressly constructed to do. Moreover, carnivores and herbivores alike have been subject to all the miseries incidental to old age, disease, and over-multiplication, and both might well put in a claim for "compensation" on this score.

On the evolutionist side, on the other hand, we are told to take comfort from the reflection that the terrible struggle for existence tends to final good, and that the suffering of the ancestor is paid for by the increased perfection of the progeny. There would be something in this argument if, in Chinese fashion, the present generation could pay its debts to its ancestors; otherwise it is not clear what compensation the *Eohippus* gets for his sorrows in the fact that, some millions of years afterwards, one of his descendants wins the Derby. And, again, it is an error to imagine that evolution signifies a constant tendency to increased perfection. That process undoubtedly involves a constant remodelling of the organism in adaptation to new conditions; but it depends on the nature of these conditions whether the direction of the modifications effected shall be upward or downward. Retrogressive is as practical as progressive metamorphosis. If what the physical philosophers tell us, that our globe has been in a state of fusion, and, like the sun, is gradually cooling down, is true; then the time must come when evolution will mean adaptation to an universal winter, and all forms of life will die out, except such low and simple organisms as the Diatom of the arctic and

antarctic ice and the Protococcus of the red snow. If our globe is proceeding from a condition in which it was too hot to support any but the lowest living thing to a condition in which it will be too cold to permit of the existence of any others, the course of life upon its surface must describe a trajectory like that of a ball fired from a mortar; and the sinking half of that course is as much a part of the general process of evolution as the rising.

From the point of view of the moralist the animal world is on about the same level as a gladiator's show. The creatures are fairly well treated, and set to fight — whereby the strongest, the swiftest, and the cunningest live to fight another day. The spectator has no need to turn his thumbs down, as no quarter is given. He must admit that the skill and training displayed are wonderful. But he must shut his eyes if he would not see that more or less enduring suffering is the meed of both vanquished and victor. And since the great game is going on in every corner of the world, thousands of times a minute; since, were our ears sharp enough, we need not descend to the gates of hell to hear —

sospiri, pianti, ed alti guai.

Voci alte e fioche, e suon di man con elle²

— it seems to follow that, if the world is governed by benevolence, it must be a different sort of benevolence from that of John Howard.³

But the old Babylonians wisely symbolized Nature by their great goddess Istar, who combined the attributes of

² . . . Sighs, complaints, and ululations loud

And voices high and hoarse, with sound of hands,
Dante, *Inferno*, Canto III:22, 27. Longfellow's translation.

³ John Howard was an eighteenth century British philanthropist who brought about important reforms in British prisons.

Aphrodite with those of Ares. Her terrible aspect is not to be ignored or covered up with shams; but it is not the only one. If the optimism of Leibnitz⁴ is a foolish though pleasant dream, the pessimism of Schopenhauer⁵ is a nightmare, the more foolish because of its hideousness. Error which is not pleasant is surely the worst form of wrong.

This may not be the best of all possible worlds, but to say that it is the worst is mere petulant nonsense. A worn-out voluptuary may find nothing good under the sun, or a vain and inexperienced youth, who cannot get the moon he cries for, may vent his irritation in pessimistic moanings; but there can be no doubt in the mind of any reasonable person that mankind could, would, and in fact do, get on fairly well with vastly less happiness and far more misery than find their way into the lives of nine people out of ten. If each and all of us had been visited by an attack of neuralgia, or of extreme mental depression, for one hour in every twenty-four — a supposition which many tolerably vigorous people know, to their cost, is not extravagant — the burden of life would have been immensely increased without much practical hindrance to its general course. Men with any manhood in them find life quite worth living under worse conditions than these.

There is another sufficiently obvious fact, which renders the hypothesis that the course of sentient nature is

⁴ Gottfried Wilhelm Leibnitz (1646-1716) was a German philosopher and mathematician who developed a complicated system of idealism. He believed that this is the best of all possible worlds, that perfection is its ethical end, and that God is its efficient cause and final harmony.

⁵ Arthur Schopenhauer (1788-1860) was a German philosopher who held that since blind force rules the world, there is no hope of the world growing better, and that happiness is secured only by the suppression of all desires and the attainment of a purely passive state.

dictated by malevolence quite untenable. A vast multitude of pleasures, and these among the purest and the best, are superfluities, bits of good which are to all appearances unnecessary as inducements to live, and are, so to speak, thrown into the bargain of life. To those who experience them, few delights can be more entrancing than such as are afforded by natural beauty, or by the arts, and especially by music; but they are products of, rather than factors in, evolution, and it is probable that they are known, in any considerable degree, to but a very small proportion of mankind.

The conclusion of the whole matter seems to be that, if Ormuzd has not had his way in this world, neither has Ahriman. Pessimism is as little consonant with the facts of sentient existence as optimism. If we desire to represent the course of nature in terms of human thought, and assume that it was intended to be that which it is, we must say that its governing principle is intellectual and not moral; that it is a materialized logical process, accompanied by pleasures and pains, the incidence of which, in the majority of cases, has not the slightest reference to moral desert. That the rain falls alike upon the just and the unjust, and that those upon whom the Tower of Siloam fell were no worse than their neighbours, seem to be Oriental modes of expressing the same conclusion.

In the strict sense of the word "nature," it denotes the sum of the phenomenal world, of that which has been, and is, and will be; and society, like art, is therefore a part of nature. But it is convenient to distinguish those parts of nature in which man plays the part of immediate cause, as something apart; and, therefore, society, like art, is usefully to be considered as distinct

from nature. It is the more desirable, and even necessary, to make this distinction, since society differs from nature in having a definite moral object; whence it comes about that the course shaped by the ethical man — the member of society or citizen — necessarily runs counter to that which the non-ethical man — the primitive savage, or man as a mere member of the animal kingdom — tends to adopt. The latter fights out the struggle for existence to the bitter end, like any other animal; the former devotes his best energies to the object of setting limits to the struggle.⁶

In the cycle of phenomena presented by the life of man, the animal, no more moral end is discernible than in that presented by the lives of the wolf and of the deer. However imperfect the relics of prehistoric men may be, the evidence which they afford clearly tends to the conclusion that, for thousands and thousands of years, before the origin of the oldest known civilizations, men were savages of a very low type. They strove with their enemies and their competitors; they preyed upon things weaker or less cunning than themselves; they were born, multiplied without stint, and died, for thousands of generations alongside the mammoth, the urus, the lion, and the hyæna, whose lives were spent in the same way; and they were no more to be praised or blamed, on moral grounds, than their less erect and more hairy compatriots.

As among these, so among primitive men, the weakest and stupidest went to the wall, while the toughest and shrewdest, those who were best fitted to cope with their circumstances, but not the best in any other sense, survived. Life was a continual free fight, and beyond the limited and temporary relations of the family, the Hob-

⁶ [The reader will observe that this is the argument of the Romanes Lecture, in brief. — 1894. T. H. H.]

Evolution and Ethics was the second Romanes Lecture.

besian⁷ war of each against all was the normal state of existence. The human species, like others, plashed and floundered amid the general stream of evolution, keeping its head above water as it best might, and thinking neither of whence nor whither.

The history of civilization — that is, of society — on the other hand, is the record of the attempts which the human race has made to escape from this position. The first men who substituted the state of mutual peace for that of mutual war, whatever the motive which impelled them to take that step, created society. But, in establishing peace, they obviously put a limit upon the struggle for existence. Between the members of that society, at any rate, it was not to be pursued *à outrance*.⁸ And of all the successive shapes which society has taken, that most nearly approaches perfection in which the war of individual against individual is most strictly limited. The primitive savage, tutored by Istar, appropriated whatever took his fancy, and killed whomsoever opposed him, if he could. On the contrary, the ideal of the ethical man is to limit his freedom of action to a sphere in which he does not interfere with the freedom of others; he seeks the common weal as much as his own; and, indeed, as an essential part of his own welfare. Peace is both end and means with him; and he founds his life on a more or less complete self-restraint, which is the negation of the unlimited struggle for existence. He tries to escape from

⁷ Thomas Hobbes (1588-1679), an important political philosopher, in his *Leviathan; or the Matter, Form, and Power of a Commonwealth, Ecclesiastical and Civil*, 1651, described the state of nature as one in which complete anarchy and barbarism prevailed. The only alternative he proposed was a state over which the sovereign had absolute power, and in which the subjects were bound to obedience by a "social contract" which derived its sanction from their fear of force and hope of personal advantage.

⁸ "To the death."

his place in the animal kingdom, founded on the free development of the principle of non-moral evolution, and to establish a kingdom of Man, governed upon the principle of moral evolution. For society not only has a moral end, but in its perfection, social life, is embodied morality.

But the effort of ethical man to work towards a moral end by no means abolished, perhaps has hardly modified, the deep-seated organic impulses which impel the natural man to follow his non-moral course. One of the most essential conditions, if not the chief cause, of the struggle for existence, is the tendency to multiply without limit, which man shares with all living things. It is notable that "increase and multiply" is a commandment traditionally much older than the ten; and that it is, perhaps, the only one which has been spontaneously and *ex animo*⁹ obeyed by the great majority of the human race. But, in civilized society, the inevitable result of such obedience is the re-establishment, in all its intensity, of that struggle for existence—the war of each against all—the mitigation or abolition of which was the chief end of social organization.

It is conceivable that, at some period in the history of the fabled Atlantis,¹⁰ the production of food should have been exactly sufficient to meet the wants of the population, that the makers of the commodities of the artificer should have amounted to just the number supportable by the surplus food of the agriculturists. And, as there is no harm in adding another monstrous supposition to the foregoing, let it be imagined that every man, woman, and child was perfectly virtuous, and aimed at the good

⁹ "From the heart," "sincerely."

¹⁰ Atlantis was a fabled island in the western ocean mentioned by classical writers. Bacon's *New Atlantis* described an ideal commonwealth on an island in the mid-Atlantic.

of all as the highest personal good. In that happy land, the natural man would have been finally put down by the ethical man. There would have been no competition, but the industry of each would have been serviceable to all; nobody being vain and nobody avaricious, there would have been no rivalries; the struggle for existence would have been abolished, and the millennium would have finally set in. But it is obvious that this state of things could have been permanent only with a stationary population. Add ten fresh mouths; and as, by the supposition, there was only exactly enough before, somebody must go on short rations. The Atlantis society might have been a heaven upon earth, the whole nation might have consisted of just men, needing no repentance, and yet somebody must starve. Reckless Istar, non-moral Nature, would have riven the ethical fabric. I was once talking with a very eminent physician¹¹ about the *vis medicatrix naturæ*.¹² "Stuff!" said he; "nine times out of ten nature does not want to cure the man: she wants to put him in his coffin." And Istar-Nature appears to have equally little sympathy with the ends of society. "Stuff! she wants nothing but a fair field and free play for her darling the strongest."

Our Atlantis may be an impossible figment, but the antagonistic tendencies which the fable adumbrates have existed in every society which was ever established, and, to all appearance, must strive for the victory in all that will be. Historians point to the greed and ambition of rulers, to the reckless turbulence of the ruled, to the debasing effects of wealth and luxury, and to the devastating wars which have formed a great part of the occupation of mankind, as the causes of the decay of states and the foundering of old civilizations, and thereby

¹¹ The late Sir W. Gull. [T. H. H.]

¹² "Healing power of nature."

point their story with a moral. No doubt immoral motives of all sorts have figured largely among the minor causes of these events. But beneath all this superficial turmoil lay the deep-seated impulse given by unlimited multiplication. In the swarms of colonies thrown out by Phœnicia and by old Greece; in the *ver sacrum*¹³ of the Latin races; in the floods of Gauls and of Teutons which burst over the frontiers of the old civilization of Europe; in the swaying to and fro of the vast Mongolian hordes in late times, the population problem comes to the front in a very visible shape. Nor is it less plainly manifest in the everlasting agrarian questions of ancient Rome than in the Arreoi societies of the Polynesian Islands.

In the ancient world, and in a large part of that in which we live, the practice of infanticide was, or is, a regular and legal custom; famine, pestilence, and war were and are normal factors in the struggle for existence, and they have served, in a gross and brutal fashion, to mitigate the intensity of the effects of its chief cause.

But, in the more advanced civilizations, the progress of private and public morality has steadily tended to remove all these checks. We declare infanticide murder, and punish it as such; we decree, not quite so successfully, that no one shall die of hunger; we regard death from preventable causes of other kinds as a sort of constructive murder, and eliminate pestilence to the best of our ability; we declaim against the curse of war, and the wickedness of the military spirit, and we are never weary of dilating on the blessedness of peace and the innocent beneficence of Industry. In their moments of expansion, even statesmen and men of business go thus far. The finer spirits to an ideal *civitas Dei*;¹⁴ a state when, every man having reached the point of ab-

¹³ "A special offering presented from the firstlings of spring."

¹⁴ "City of God."

solute self-negation, and having nothing but moral perfection to strive after, peace will truly reign, not merely among nations, but among men, and the struggle for existence will be at an end.

Whether human nature is competent, under any circumstances, to reach, or even seriously advance towards, this ideal condition, is a question which need not be discussed. It will be admitted that mankind has not yet reached this stage by a very long way, and my business is with the present. And that which I wish to point out is that, so long as the natural man increases and multiplies without restraint, so long will peace and industry not only permit, but they will necessitate, a struggle for existence as sharp as any that ever went on under the *régime* of war. If Istar is to reign on the one hand, she will demand her human sacrifices on the other.

Let us look at home. For seventy years peace and industry have had their way among us with less interruption and under more favourable conditions than in any other country on the face of the earth. The wealth of Cræsus was nothing to that which we have accumulated, and our prosperity has filled the world with envy. But Nemesis did not forget Cræsus: has she forgotten us?

I think not. There are now 36,000,000 of people in our islands, and every year considerably more than 300,000 are added to our numbers.¹⁵ That is to say, about every hundred seconds, or so, a new claimant to a share in the common stock or maintenance presents him or herself among us. At the present time, the produce of the soil does not suffice to feed half its population. The other moiety has to be supplied with food

¹⁵ These numbers are only approximately accurate. In 1881, our population amounted to 35,241,482, exceeding the number in 1871 by 3,396,103. The average annual increase in the decennial period 1871-1881 is therefore 339,610. The number of minutes in a calendar year is 525,600. [T. H. H.]

which must be bought from the people of food-producing countries. That is to say, we have to offer them the things which they want in exchange for the things we want. And the things they want and which we can produce better than they are mainly manufactures — industrial products.

The insolent reproach of the first Napoleon had a very solid foundation. We not only are, but, under penalty of starvation, we are bound to be, a nation of shopkeepers. But other nations also lie under the same necessity of keeping shop, and some of them deal in the same goods as ourselves. Our customers naturally seek to get the most and the best in exchange for their produce. If our goods are inferior to those of our competitors, there is no ground, compatible with the sanity of the buyers, which can be alleged, why they should not prefer the latter. And, if that result should ever take place on a large and general scale, five or six millions of us would soon have nothing to eat. We know what the cotton famine¹⁶ was; and we can therefore form some notion of what a dearth of customers would be.

Judged by an ethical standard, nothing can be less satisfactory than the position in which we find ourselves. In a real, though incomplete, degree we have attained the condition of peace which is the main object of social organization; and, for argument's sake, it may be assumed that we desire nothing but that which is in itself innocent and praiseworthy — namely, the enjoyment of the fruits of honest industry. And lo! in spite of ourselves, we are in reality engaged in an internecine struggle for existence with our presumably no less peaceful and well-meaning neighbours. We seek peace and we do

¹⁶ During the American Civil War importations of cotton to England were cut off, and thousands of cotton workers were thrown out of work and into destitution.

not ensue it. The moral nature in us asks for no more than is compatible with the general good; the non-moral nature proclaims and acts upon that fine old Scottish family motto, "Thou shalt starve ere I want." Let us be under no illusions, then. So long as unlimited multiplication goes on, no social organization which has ever been devised, or is likely to be devised, no fiddle-faddling with the distribution of wealth, will deliver society from the tendency to be destroyed by the reproduction within itself, in its intensest form, of that struggle for existence the limitation of which is the object of society. And however shocking to the moral sense this eternal competition of man against man and of nation against nation may be; however revolting may be the accumulation of misery at the negative pole of society, in contrast with that of monstrous wealth at the positive pole;¹⁷ this state of things must abide, and grow continually worse, so long as Istar holds her way unchecked. It is the true riddle of the Sphinx; and every nation which does not solve it will sooner or later be devoured by the monster itself has generated.

The practical and pressing question for us, just now, seems to me to be how to gain time. "Time brings counsel," as the Teutonic proverb has it; and wiser folk among our posterity may see their way out of that which at present looks like an *impasse*.

It would be folly to entertain any ill-feeling towards those neighbours and rivals who, like ourselves, are slaves of Istar; but, if somebody is to be starved, the modern world has no Oracle of Delphi to which the nations can appeal for an indication of the victim. It is open to us

¹⁷ [It is hard to say whether the increase of the unemployed poor, or that of the unemployed rich, is the greater social evil. — 1894. T. H. H.]

to try our fortune; and, if we avoid impending fate, there will be a certain ground for believing that we are the right people to escape. *Securus judicat orbis.*¹⁸

To this end, it is well to look into the necessary condition of our salvation by works. They are two, one plain to all the world and hardly needing insistence; the other seemingly not so plain, since too often it has been theoretically and practically left out of sight. The obvious condition is that our produce shall be better than that of others. There is only one reason why our goods should be preferred to those of our rivals — our customers must find them better at the price. That means that we must use more knowledge, skill, and industry in producing them, without a proportionate increase in the cost of production; and, as the price of labour constitutes a large element in that cost, the rate of wages must be restricted within certain limits. It is perfectly true that cheap production and cheap labour are by no means synonymous; but it is also true that wages cannot increase beyond a certain proportion without destroying cheapness. Cheapness, then, with, as part and parcel of cheapness, a moderate price of labour, is essential to our success as competitors in the markets of the world.

The second condition is really quite as plainly indispensable as the first, if one thinks seriously about the matter. It is social stability. Society is stable, when the wants of its members obtain as much satisfaction as, life being what it is, common sense and experience show may be reasonably expected. Mankind, in general, care very little for forms of government or ideal considerations of any sort; and nothing really stirs the great multitude to break with custom and incur the manifest perils of revolt except the belief that misery in this world, or

¹⁸ "Unconcerned about the world, he rules."

damnation in the next, or both, are threatened by the continuance of the state of things in which they have been brought up. But when they do attain that conviction, society becomes as unstable as a package of dynamite, and a very small matter will produce the explosion which sends it back to the chaos of savagery.

It needs no argument to prove that when the price of labour sinks below a certain point, the worker infallibly falls into that condition which the French emphatically call *la misère* — a word for which I do not think there is any exact English equivalent. It is a condition in which the food, warmth, and clothing which are necessary for the mere maintenance of the functions of the body in their normal state cannot be obtained; in which men, women, and children are forced to crowd into dens wherein decency is abolished and the most ordinary conditions of healthful existence are impossible of attainment; in which the pleasures within reach are reduced to bestiality and drunkenness; in which the pains accumulate at compound interest, in the shape of starvation, disease, stunted development, and moral degradation; in which the prospect of even steady and honest industry is a life of unsuccessful battling with hunger, rounded by a pauper's grave.

That a certain proportion of the members of every great aggregation of mankind should constantly tend to establish and populate such a Slough of Despond as this is inevitable, so long as some people are by nature idle and vicious, while others are disabled by sickness or accident, or thrown upon the world by the death of their bread-winners. So long as that proportion is restricted within tolerable limits, it can be dealt with; and, so far as it arises only from such causes, its existence may and must be patiently borne. But, when the organization of society, instead of mitigating this ten-

dency, tends to continue and intensify it; when a given social order plainly makes for evil and not for good, men naturally enough begin to think it high time to try a fresh experiment. The animal man, finding that the ethical man has landed him in such a slough, resumes his ancient sovereignty, and preaches anarchy; which is, substantially, a proposal to reduce the social cosmos to chaos, and begin the brute struggle for existence once again.

Any one who is acquainted with the state of the population of all great industrial centres, whether in this or other countries, is aware that, amidst a large and increasing body of that population, *la misère* reigns supreme. I have no pretensions to the character of a philanthropist, and I have a special horror of all sorts of sentimental rhetoric; I am merely trying to deal with facts, to some extent within my own knowledge, and further evidenced by abundant testimony, as a naturalist; and I take it to be a mere plain truth that, throughout industrial Europe, there is not a single large manufacturing city which is free from a vast mass of people whose condition is exactly that described; and from a still greater mass who, living just on the edge of the social swamp, are liable to be precipitated into it by any lack of demand for their produce. And, with every addition to the population, the multitude already sunk in the pit and the number of the host sliding towards it continually increase.

Argumentation can hardly be needful to make it clear that no society in which the elements of decomposition are thus swiftly and surely accumulating can hope to win in the race of industries.

Intelligence, knowledge, and skill are undoubtedly conditions of success; but of what avail are they likely to be unless they are backed up by honesty, energy, good-

will, and all the physical and moral faculties that go to the making of manhood, and unless they are stimulated by hope of such reward as men may fairly look to? And what dweller in the slough of want, dwarfed in body and soul, demoralized, hopeless, can reasonably be expected to possess these qualities?

Any full and permanent development of the productive powers of an industrial population, then, must be compatible with and, indeed, based upon a social organization which will secure a fair amount of physical and moral welfare to that population; which will make for good and not for evil. Natural science and religious enthusiasm rarely go hand in hand, but on this matter their concord is complete; and the least sympathetic of naturalists can but admire the insight and the devotion of such social reformers as the late Lord Shaftesbury,¹⁹ whose recently published "Life and Letters" gives a vivid picture of the condition of the working classes fifty years ago, and of the pit which our industry, ignoring these plain truths, was then digging under its own feet.

There is, perhaps, no more hopeful sign of progress among us, in the last half-century, than the steadily increasing devotion which has been and is directed to measures for promoting physical and moral welfare among the poorer classes. Sanitary reformers, like most other reformers whom I have had the advantage of knowing, seem to need a good dose of fanaticism, as a sort of moral coca, to keep them up to the mark, and, doubtless, they have made many mistakes; but that the endeavour to improve the condition under which our industrial population live, to amend the drainage of

¹⁹ Anthony Ashley Cooper, seventh Lord Shaftesbury (1801-1885), was a philanthropist who was active in improving the conditions of the working classes.

densely peopled streets, to provide baths, washhouses, and gymnasia, to facilitate habits of thrift, to furnish some provision for instruction and amusement in public libraries and the like, is not only desirable from a philanthropic point of view, but an essential condition of safe industrial development, appears to me to be indisputable. It is by such means alone, so far as I can see, that we can hope to check the constant gravitation of industrial society towards *la misère*, until the general progress of intelligence and morality leads men to grapple with the sources of that tendency. If it is said that the carrying out of such arrangements as those indicated must enhance the cost of production, and thus handicap the producer in the race of competition, I venture, in the first place, to doubt the fact; but if it be so, it results that industrial society has to face a dilemma, either alternative of which threatens destruction.

On the one hand, a population the labour of which is sufficiently remunerated may be physically and morally healthy and socially stable, but may fail in industrial competition by reason of the dearness of its produce. On the other hand, a population the labour of which is insufficiently remunerated must become physically and morally unhealthy, and socially unstable; and though it may succeed for a while in industrial competition, by reason of the cheapness of its produce, it must in the end fall, through hideous misery and degradation, to utter ruin.

Well, if these are the only possible alternatives, let us for ourselves and our children choose the former, and, if need be, starve like men. But I do not believe that the stable society made up of healthy, vigorous, instructed, and self-ruling people would ever incur serious risk of that fate. They are not likely to be troubled with many competitors of the same character,

just yet; and they may be safely trusted to find ways of holding their own.

Assuming that the physical and moral well-being and the stable social order, which are the indispensable conditions of permanent industrial development, are secured, there remains for consideration the means of attaining that knowledge and skill without which, even then, the battle of competition cannot be successfully fought. Let us consider how we stand. A vast system of elementary education has now been in operation among us for sixteen years,²⁰ and has reached all but a very small fraction of the population. I do not think that there is any room for doubt that, on the whole, it has worked well, and that its indirect no less than its direct benefits have been immense. But, as might be expected, it exhibits the defects of all our educational systems—fashioned as they were to meet the wants of a bygone condition of society. There is a widespread and, I think, well-justified complaint that it has too much to do with books and too little to do with things. I am as little disposed as any one can well be to narrow early education and to make the primary school a mere annex of the shop. And it is not so much in the interests of industry, as in that of breadth of culture, that I echo the common complaint against the bookish and theoretical character of our primary instruction.

If there were no such things as industrial pursuits, a system of education which does nothing for the faculties of observation, which trains neither the eye nor the hand, and is compatible with utter ignorance of the

²⁰ The Education Bill of 1870 was the beginning of the present organized system of popular education in England. Huxley has a number of addresses on the general subject of education, one of which, *Science and Art*, and an extract from another, *A Liberal Education*, appear in this volume. These and others compose *Science and Education, Collected Essays*, volume III.

commonest natural truths, might still be reasonably regarded as strangely imperfect. And when we consider that the instruction and training which are lacking are exactly those which are of most importance for the great mass of our population, the fault becomes almost a crime, the more that there is no practical difficulty in making good these defects. There really is no reason why drawing should not be universally taught, and it is an admirable training for both eye and hand. Artists are born, not made; but everybody may be taught to draw elevations, plans, and sections; and pots and pans are as good, indeed better, models for this purpose than the Apollo Belvedere. The plant is not expensive; and there is this excellent quality about drawing of the kind indicated, that it can be tested almost as easily and severely as arithmetic. Such drawings are either right or wrong, and if they are wrong the pupil can be made to see that they are wrong. From the industrial point of view, drawing has the further merit that there is hardly any trade in which the power of drawing is not of daily and hourly utility. In the next place, no good reason, except the want of capable teachers, can be assigned why elementary notions of science should not be an element in general instruction. In this case, again, no expensive or elaborate apparatus is necessary. The commonest thing — a candle, a boy's squirt, a piece of chalk — in the hands of a teacher who knows his business, may be made the starting-point whence children may be led into the regions of science as far as their capacity permits, with efficient exercise of their observational and reasoning faculties on the road. If object lessons often prove trivial failures, it is not the fault of object lessons, but that of the teacher, who has not found out how much the power of teaching a little depends on knowing a great deal, and that thoroughly;

and that he has not made that discovery is not the fault of the teachers, but of the detestable system of training them which is widely prevalent.²¹

As I have said, I do not regard the proposal to add these to the present subjects of universal instruction as made merely in the interests of industry. Elementary science and drawing are just as needful at Eton²² (where I am happy to say both are now parts of the regular course) as in the lowest primary school. But their importance in the education of the artisan is enhanced, not merely by the fact that the knowledge and skill thus gained—little as they may amount to—will still be of practical utility to him; but, further, because they constitute an introduction to that special training which is commonly called “technical education.”

I conceive that our wants in this last direction may be grouped under three heads: (1) Instruction in the principles of those branches of science and of art which are peculiarly applicable to industrial pursuits, which may be called preliminary scientific education. (2) Instruction in the special branches of such applied science and art, as technical education proper. (3) Instruction of teachers in both these branches. (4) Capacity-catching machinery.

A great deal has already been done in each of these directions, but much remains to be done. If elementary education is amended in the way that has been sug-

²¹ Training in the use of simple tools is no doubt very desirable, on all grounds. From the point of view of “culture,” the man whose “fingers are all thumbs” is but a stunted creature. But the practical difficulties in the way of introducing handiwork of this kind into elementary schools appear to me to be considerable. [T. H. H.]

²² Eton College is perhaps the best of the great English “public schools.” Huxley was a governor of the college from 1879 to 1888.

gested, I think that the school-boards will have quite as much on their hands as they are capable of doing well. The influences under which the members of these bodies are elected do not tend to secure fitness for dealing with scientific or technical education; and it is the less necessary to burden them with an uncongenial task, as there are other organizations, not only much better fitted to do the work, but already actually doing it.

In the matter of preliminary scientific education, the chief of these is the Science and Art Department,²³ which has done more during the last quarter of a century for the teaching of elementary science among the masses of the people than any organization which exists either in this or in any other country. It has become veritably a people's university, so far as physical science is concerned. At the foundation of our old universities they were freely open to the poorest, but the poorest must come to them. In the last quarter of a century, the Science and Art Department, by means of its classes spread all over the country and open to all, has conveyed instruction to the poorest. The University Extension movement²⁴ shows that our older learned cor-

²³ The Science and Art Department, now the Board of Education, was created in 1853 and in 1857 established at South Kensington. It is a department of government having general charge of education. Huxley speaks of this department, which he served as examiner, as "a measure which came into existence unnoticed, but which will, I believe, turn out to be of more importance to the welfare of the people than many political changes over which the noise of battle has rent the air." *Scientific Education* 1869, *Collected Essays*, III:131.

²⁴ The University Extension movement was commenced by James Stuart, of the University of Cambridge, who wished to establish "a sort of peripatetic university, the professors of which would circulate among the big towns and thus give a wider opportunity for receiving such a teaching." His system was officially adopted by the University of Cambridge in 1873, and by London University and the University of Oxford soon after.

porations have discovered the propriety of following suit.

Technical education, in the strict sense, has become a necessity for two reasons. The old apprenticeship system has broken down, partly by reason of the changed conditions of industrial life, and partly because trades have ceased to be "crafts," the traditional secrets whereof the master handed down to his apprentices. Invention is constantly changing the face of our industries, so that "use and wont," "rule of thumb," and the like, are gradually losing their importance, while that knowledge of principles which alone can deal successfully with changed conditions is becoming more and more valuable. Socially, the "master" of four or five apprentices is disappearing in favour of the "employer" of forty, or four hundred, or four thousands, "hands," and the odds and ends of technical knowledge, formerly picked up in a shop, are not, and cannot be, supplied in the factory. The instruction formerly given by the master must therefore be more than replaced by the systematic teaching of the technical school.

Institutions of this kind on varying scales of magnitude and completeness, from the splendid edifice set up by the City and Guilds Institute²⁵ to the smallest local technical school, to say nothing of classes, such as those in technology instituted by the Society of Arts²⁶ (subsequently taken over by the City Guilds), have been

²⁵ The City and Guilds of London Institute exists "for the establishment of, or for the assistance to, trade schools, for the conduct of examinations, and for subsidizing other institutions, in London or in the provinces, having cognate subjects." The Institute provides instruction in lower technical and trade subjects, in engineering, and in pure science. Much of its work is carried on by evening classes and "extension" lectures.

²⁶ The Society of Arts, founded in 1754, has for its object education of various kinds, especially in pure and applied arts.

established in various parts of the country, and the movement in favour of their increase and multiplication is rapidly growing in breadth and intensity. But there is much difference of opinion as to the best way in which the technical instruction, so generally desired, should be given. Two courses appear to be practicable: the one is the establishment of special technical schools with a systematic and lengthened course of instruction demanding the employment of the whole time of the pupils. The other is the setting afoot of technical classes, especially evening classes, comprising a short series of lessons on some special topic, which may be attended by persons already earning wages in some branch of trade or commerce.

There is no doubt that technical schools, on the plan indicated under the first head, are extremely costly; and, so far as the teaching of artisans is concerned, it is very commonly objected to them that, as the learners do not work under trade conditions, they are apt to fall into amateurish habits, which prove of more hindrance than service in the actual business of life. When such schools are attached to factories under the direction of an employer who desires to train up a supply of intelligent workmen, of course this objection does not apply; nor can the usefulness of such schools for the training of future employers and for the higher grade of the employed be doubtful; but they are clearly out of the reach of the great mass of the people, who have to earn their bread as soon as possible. We must therefore look to the classes, and especially to evening classes, as the great instrument for the technical education of the artisan. The utility of such classes has now been placed beyond all doubt; the only question which remains is to find the ways and means of extending them.

We are here, as in all other questions of social or-

ganization, met by two diametrically opposed views. On the one hand, the methods pursued in foreign countries are held up as our example. The State is exhorted to take the matter in hand, and establish a great system of technical education. On the other hand, many economists of the individualist school exhaust the resources of language in condemning and repudiating, not merely the interference of the general government in such matters, but the application of a farthing of the funds raised by local taxation to these purposes. I entertain a strong conviction that, in this country, at any rate, the State had much better leave purely technical and trade instruction alone. But, although my personal leanings are decidedly towards the individualists, I have arrived at that conclusion on merely practical grounds. In fact, my individualism is rather of a sentimental sort, and I sometimes think I should be stronger in the faith if it were less vehemently advocated.²⁷ I am unable to see that civil society is anything but a corporation established for a moral object only—namely, the good of its members—and therefore that it may take such measures as seem fitting for the attainment of that which the general voice decides to be the general good. That the suffrage of the majority is by no means a scientific test of social good and evil is unfortunately too true; but, in practice, it is the only test we can apply, and the refusal to abide by it means anarchy. The purest despotism that ever existed is as much based upon that will of the majority (which is usually submission to the will of a small minority) as the freest republic. Law

²⁷ In what follows I am only repeating and emphasizing opinions which I expressed seventeen years ago, in an Address to the members of the Midland Institute (republished in *Critiques and Addresses* in 1873, and in Vol. I, of these *Essays*). I have seen no reason to modify them, notwithstanding high authority on the other side. [T. H. H.]

is the expression of the opinion of the majority; and it is law, and not mere opinion, because the many are strong enough to enforce it.

I am as strongly convinced as the most pronounced individualist can be, that it is desirable that every man should be free to act in every way which does not limit the corresponding freedom of his fellow-man. But I fail to connect that great induction of political science with the practical corollary which is frequently drawn from it: that the State—that is, the people in their corporate capacity—has no business to meddle with anything but the administration of justice and external defence. It appears to me that the amount of freedom which incorporate society may fitly leave to its members is not a fixed quantity, to be determined *a priori* by deduction from the fiction called “natural rights”; but that it must be determined by, and vary with, circumstances. I conceive it to be demonstrable that the higher and the more complex the organization of the social body, the more closely is the life of each member bound up with that of the whole; and the larger becomes the category of acts which cease to be merely self-regarding, and which interfere with the freedom of others more or less seriously.

If a squatter, living ten miles away from any neighbour, chooses to burn his house down to get rid of vermin, there may be no necessity (in the absence of insurance offices) that the law should interfere with his freedom of action; his act can hurt nobody but himself. But, if the dweller in a street chooses to do the same thing, the State very properly makes such a proceeding a crime, and punishes it as such. He does meddle with his neighbour's freedom, and that seriously. So it might, perhaps, be a tenable doctrine, that it would be needless, and even tyrannous, to make education compulsory in

a sparse agricultural population, living in abundance on the produce of its own soil; but, in a densely populated manufacturing country, struggling for existence with competitors, every ignorant person tends to become a burden upon, and, so far, an infringer of the liberty of, his fellows, and an obstacle to their success. Under such circumstances an education rate is, in fact, a war tax, levied for purposes of defence.

That State action always has been more or less mis-directed, and always will be so, is, I believe, perfectly true. But I am not aware that it is more true of the action of men in their corporate capacity than it is of the doings of individuals. The wisest and most dispassionate man in existence, merely wishing to go from one stile in a field to the opposite, will not walk quite straight — he is always going a little wrong, and always correcting himself; and I can only congratulate the individualist who is able to say that his general course of life has been of a less undulatory character. To abolish State action, because its direction is never more than approximately correct, appears to me to be much the same thing as abolishing the man at the wheel altogether, because, do what he will, the ship yaws more or less. "Why should I be robbed of my property to pay for teaching another man's children?" is an individualist question, which is not unfrequently put as if it settled the whole business. Perhaps it does, but I find difficulties in seeing why it should. The parish in which I live makes me pay my share for the paving and lighting of a great many streets that I never pass through; and I might plead that I am robbed to smooth the way and lighten the darkness of other people. But I am afraid the parochial authorities would not let me off on this plea; and I must confess I do not see why they should.

I cannot speak of my own knowledge, but I have

every reason to believe that I came into this world a small reddish person, certainly without a gold spoon in my mouth, and in fact with no discernible abstract or concrete "rights" or property of any description. If a foot was not set upon me, at once, as a squalling nuisance, it was either the natural affection of those about me, which I certainly had done nothing to deserve, or the fear of the law which, ages before my birth, was painfully built up by the society into which I intruded, that prevented that catastrophe. If I was nourished, cared for, taught, saved from the vagabondage of a wastrel, I certainly am not aware that I did anything to deserve those advantages. And, if I possess anything now, it strikes me that, though I may have fairly earned my day's wages for my day's work, and may justly call them my property — yet, without that organization of society, created out of the toil and blood of long generations before my time, I should probably have had nothing but a flint axe and an indifferent hut to call my own; and even those would be mine only so long as no stronger savage came my way.

So that if society, having, quite gratuitously, done all these things for me, asks me in turn to do something towards its preservation — even if that something is to contribute to the teaching of other men's children — I really, in spite of all my individualist leanings, feel rather ashamed to say no. And if I were not ashamed, I cannot say that I think that society would be dealing unjustly with me in converting the moral obligation into a legal one. There is a manifest unfairness in letting all the burden be borne by the willing horse.

It does not appear to me, then, that there is any valid objection to taxation for purposes of education; but, in the case of technical schools and classes, I think it is practically expedient that such a taxation should

be local. Our industrial population accumulates in particular towns and districts; these districts are those which immediately profit by technical education; and it is only in them that we can find the men practically engaged in industries, among whom some may reasonably be expected to be competent judges of that which is wanted, and of the best means of meeting the want.

In my belief, all methods of technical training are at present tentative, and, to be successful, each must be adapted to the special peculiarities of its locality. This is a case in which we want twenty years, not of "strong government," but of cheerful and hopeful blundering; and we may be thankful if we get things straight in that time.

The principle of the Bill introduced, but dropped, by the Government last session, appears to me to be wise, and some of the objections to it I think are due to a misunderstanding. The Bill proposed in substance to allow localities to tax themselves for purposes of technical education — on the condition that any scheme for such purpose should be submitted to the Science and Art Department, and declared by that department to be in accordance with the intention of the Legislature.

A cry was raised that the Bill proposed to throw technical education into the hands of the Science and Art Department. But, in reality, no power of initiation, nor even of meddling with details, was given to that Department — the sole function of which was to decide whether any plan proposed did or did not come within the limits of "technical education." The necessity for such control, somewhere, is obvious. No legislature, certainly not ours, is likely to grant the power of self-taxation without setting limits to that power in some way; and it would neither have been practicable to devise a legal definition of technical education, nor com-

mendable to leave the question to the Auditor-General, to be fought out in the law-courts. The only alternative was to leave the decision to an appropriate State authority. If it is asked what is the need of such control if the people of the localities are the best judges, the obvious reply is that there are localities and localities, and that while Manchester, or Liverpool, or Birmingham, or Glasgow might, perhaps, be safely left to do as they thought fit, smaller towns, in which there is less certainty of full discussion by competent people of different ways of thinking, might easily fall a prey to crocheteers.

Supposing our intermediate science teaching and our technical schools and classes are established, there is yet a third need to be supplied, and that is the want of good teachers. And it is necessary not only to get them, but to keep them when you have got them.

It is impossible to insist too strongly upon the fact that the efficient teachers of science and of technology are not to be made by the processes in vogue at ordinary training colleges. The memory loaded with mere book-work is not the thing wanted — is, in fact, rather worse than useless — in the teacher of scientific subjects. It is absolutely essential that his mind should be full of knowledge and not of mere learning, and that what he knows should have been learned in the laboratory rather than in the library. There are happily already, both in London and in the provinces, various places in which such training is to be had, and the main thing at present is to make it in the first place accessible, and in the next indispensable, to those who undertake the business of teaching. But when the well-trained men are supplied, it must be recollected that the profession of teacher is not a very lucrative or otherwise tempting one, and that it may be advisable to offer special inducements to good men to remain in it. These, however, are ques-

tions of detail into which it is unnecessary to enter further.

Last, but not least, comes the question of providing the machinery for enabling those who are by nature specially qualified to undertake the higher branches of industrial work, to reach the position in which they may render that service to the community. If all our educational expenditure did nothing but pick one man of scientific or inventive genius, each year, from amidst the hewers of wood and drawers of water, and give him the chance of making the best of his inborn faculties, it would be a very good investment. If there is one such child among the hundreds of thousands of our annual increase, it would be worth any money to drag him either from the slough of misery, or from the hotbed of wealth, and teach him to devote himself to the service of his people. Here, again, we have made a beginning with our scholarships and the like, and need only follow in the tracks already worn.

The programme of industrial development briefly set forth in the preceding pages is not what Kant calls a "Hirngespinnst," a cobweb spun in the brain of a Utopian philosopher. More or less of it has taken bodily shape in many parts of the country, and there are towns of no great size or wealth in the manufacturing districts (Keighley, for example) in which almost the whole of it has, for some time, been carried out, so far as the means at the disposal of the energetic and public-spirited men who have taken the matter in hand permitted. The thing can be done; I have endeavoured to show good grounds for the belief that it must be done, and that speedily, if we wish to hold our own in the war of industry. I doubt not that it will be done, whenever its absolute necessity becomes as apparent to

all those who are absorbed in the actual business of industrial life as it is to some of the lookers on.

Perhaps it is necessary for me to add that technical education is not here proposed as a panacea for social diseases, but simply as a medicament which will help the patient to pass through an imminent crisis.

An ophthalmic surgeon may recommend an operation for cataract in a man who is going blind, without being supposed to undertake that it will cure him of gout. And I may pursue the metaphor so far as to remark that the surgeon is justified in pointing out that a diet of pork-chops and burgundy will probably kill his patient, though he may be quite unable to suggest a mode of living which will free him from his constitutional disorder.

Mr. Booth²⁸ asks me, Why do you not propose some plan of your own? Really, that is no answer to my argument that his treatment will make the patient very much worse. [Note added in *Social Diseases and Worse Remedies*, January, 1891.]

²⁸ "General" William Booth was the leader of the Salvation Army. His absolute power and the irresponsible administration of the society's funds were the chief reasons for Huxley's criticism of the work of the Salvation Army in the *Letters to the "Times" on the "Darkest England Scheme,"* *Collected Essays*, IX:237 ff.

SCIENCE AND CULTURE ¹

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. In fact, so far as mere argument goes, they have been subjected to such a *feu d'enfer*² that it is

¹ This address was delivered at the opening of Sir Josiah Mason's Science College at Birmingham, October 1, 1880. It was published in *Science and Culture*, 1881, and in *Science and Education, Collected Essays*, III:134-159. I have omitted a few paragraphs from the beginning of the address.

² "Fire from hell."

a miracle if any have escaped. But I have remarked that your typical practical man has an unexpected resemblance to one of Milton's angels. 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." And he devoted a large part of his wealth and five years of incessant work to this end.

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 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 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."

It does not concern me at present to dwell upon the first two injunctions any longer than may be needful to express my full conviction of their wisdom. 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." And, as I am afraid it is not permissible to speak of this form of opposition to scientific education in the past tense; may we not expect to be told that this, not only omission, but prohibition, of "mere literary instruction and education" is a patent example of scientific narrow-mindedness?

I am not acquainted with Sir Josiah Mason's reasons for the action which he has taken; but if, as I apprehend is the case, he refers to the ordinary classical course of our schools and universities by the name of "mere literary instruction and education," I venture to offer sundry reasons of my own in support of that action.

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 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.

Mr. Arnold tells us that the meaning of culture is "to know the best that has been thought and said in the world." It is the criticism of life contained in literature. 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?"³

We have here to deal with two distinct propositions. 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 learnt 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

³ *Essays in Criticism*, p. 37. [T. H. H.]

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 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. 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. Indeed, as nature had been cursed for man's sake, it was an obvious conclusion that those who meddled with nature were likely to come into pretty close contact with Satan. 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.

And justly. For, saving Dante⁴ on his solitary pinnacle, there was no figure in modern literature at the

⁴ Dante Alighieri (1265-1321) wrote *La Commedia*, usually called the *Divine Comedy*, a great allegory. The poem is a vision of the next world, as it was then conceived, of hell, of purgatory, and of paradise.

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 recognised 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 Nemesis⁵ 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

⁵ The Greek divinity who dealt out retributive justice.

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.

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 very certain that the earth is not the chief body in the material universe, and that the world is not subordinated to man's use. 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,⁶ and know no more of the chief causes of the present intellectual fermentation than Erasmus did. Scholarly and pious persons, worthy of all respect, favour us with allocutions upon the sadness of the antagonism of science to their mediæval 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*⁷ 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

⁶ Desiderius Erasmus (1467-1536), a Dutch scholar, was probably the most important of the Renaissance scholars. The *Colloquia*, 1509, a series of dialogues on social, religious, and educational subjects, was his greatest work.

⁷ "Thou too."

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.⁸ Modern astronomy is the natural continuation and development of the work of Hipparchus and of Ptolemy;⁹ modern physics of that of Democritus and of Archimedes;¹⁰ it was long before modern biological science outgrew the knowledge bequeathed to us by Aristotle, by Theophrastus, and by Galen.¹¹

We cannot know all the best thoughts and sayings of the Greeks unless we know what they thought about natural phenomena. We cannot fully apprehend their

⁸ Euclid's *Elements* of geometry was written in the third century B.C. Euclid was a Greek scholar who lived in Alexandria during the reign of Ptolemy I. Alexandria, though in Egypt, was for a time the centre of Greek learning, and was noted for the fine library founded by Ptolemy I.

⁹ Hipparchus (2nd century B.C.) was a Greek astronomer who discovered the precession of the equinoxes, prepared a catalogue of stars, founded astronomy, and invented the system of indicating geographical positions by means of the circles of latitude and longitude. Ptolemy was the famous Alexandrian astronomer who gave his name to the system of astronomy which first represented the earth as a globe and the planets as revolving around it.

¹⁰ Democritus, a Greek physical philosopher of the fifth century B.C., is chiefly known for the atomic theory which he expounded. Archimedes (B.C. 287-212) is said to have discovered the principles on which the theory of specific gravity is based, the Archimedean screw, and various burning devices and hurling engines used in ancient warfare.

¹¹ Aristotle (B.C. 384-322) was a pupil of Plato and an important critic, logician, and moral and political philosopher. As the creator of natural science he first divided the animal kingdom into classes, and he came near discovering the circulation of the blood. Theophrastus (B.C. 372-287) was a pupil of Plato and Aristotle and was particularly interested in botany. Claudius Galen (A.D. 130-200), a Greek physician, was regarded until the sixteenth century as the greatest authority on anatomy and physiology.

criticism of life unless we understand the extent to which that criticism was affected by scientific conceptions. We falsely pretend to be the inheritors of their culture, unless we are penetrated, as the best minds among them were, with an unhesitating faith that the free employment of reason, in accordance with scientific method, is the sole method of reaching truth.

Thus I venture to think that the pretensions of our modern Humanists to the possession of the monopoly of culture and to the exclusive inheritance of the spirit of antiquity must be abated, if not abandoned. But I should be very sorry that anything I have said should be taken to imply a desire on my part to depreciate the value of classical education, as it might be and as it sometimes is. The native capacities of mankind vary no less than their opportunities; and while culture is one, the road by which one man may best reach it is widely different from that which is most advantageous to another. Again, while scientific education is yet inchoate and tentative, classical education is thoroughly well organised upon the practical experience of generations of teachers. So that, given ample time for learning and estimation for ordinary life, or for a literary career, I do not think that a young Englishman in search of culture can do better than follow the course usually marked out for him, supplementing its deficiencies by his own efforts.

But for those who mean to make science their serious occupation; or who intend to follow the profession of medicine; or who have to enter early upon the business of life; for all these, in my opinion, classical education is a mistake; and it is for this reason that I am glad to see "mere literary education and instruction" shut out from the curriculum of Sir Josiah Mason's College, seeing that its inclusion would probably lead to the

introduction of the ordinary smattering of Latin and Greek.

Nevertheless, I am the last person to question the importance of genuine literary education, or to suppose that intellectual culture can be complete without it. An exclusively scientific training will bring about a mental twist as surely as an exclusively literary training. The value of the cargo does not compensate for a ship's being out of trim; and I should be very sorry to think that the Scientific College would turn out none but lop-sided men.

There is no need, however, that such a catastrophe should happen. Instruction in English, French, and German is provided, and thus the three greatest literatures of the modern world are made accessible to the student.

French and German, and especially the latter language, are absolutely indispensable to those who desire full knowledge in any department of science. But even supposing that the knowledge of these languages acquired is not more than sufficient for purely scientific purposes, every Englishman has, in his native tongue, an almost perfect instrument of literary expression; and, in his own literature, models of every kind of literary excellence. If an Englishman cannot get literary culture out of his Bible, his Shakespeare, his Milton, neither, in my belief, will the profoundest study of Homer and Sophocles, Virgil and Horace, give it to him.

Thus, since the constitution of the College makes sufficient provision for literary as well as for scientific education, and since artistic instruction is also contemplated, it seems to me that a fairly complete culture is offered to all who are willing to take advantage of it.

But I am not sure that at this point the "practical" man, scotched but not slain, may ask what all this talk

about culture has to do with an Institution, the object of which is defined to be "to promote the prosperity of the manufactures and the industry of the country." He may suggest that what is wanted for this end is not culture, nor even a purely scientific discipline, but simply a knowledge of applied science.

I often wish that this phrase, "applied science," had never been invented. For it suggests that there is a sort of scientific knowledge of direct practical use, which can be studied apart from another sort of scientific knowledge, which is of no practical utility, and which is termed "pure science." But there is no more complete fallacy than this. What people call applied science is nothing but the application of pure science to particular classes of problems. It consists of deductions from those general principles, established by reasoning and observation, which constitute pure science. No one can safely make these deductions until he has a firm grasp of the principles; and he can obtain that grasp only by personal experience of the operations of observation and of reasoning on which they are founded.

Almost all the processes employed in the arts and manufactures fall within the range either of physics or of chemistry. In order to improve them, one must thoroughly understand them; and no one has a chance of really understanding them, unless he has obtained that mastery of principles and that habit of dealing with facts, which is given by long-continued and well-directed purely scientific training in the physical and the chemical laboratory. So that there really is no question as to the necessity of purely scientific discipline, even if the work of the College were limited by the narrowest interpretation of its stated aims.

And, as to the desirableness of a wider culture than that yielded by science alone, it is to be recollected that

the improvement of manufacturing processes is only one of the conditions which contribute to the prosperity of industry. Industry is a means and not an end; and mankind work only to get something which they want. What that something is depends partly on their innate, and partly on their acquired, desires.

If the wealth resulting from prosperous industry is to be spent upon the gratification of unworthy desires, if the increasing perfection of manufacturing processes is to be accompanied by an increasing debasement of those who carry them on, I do not see the good of industry and prosperity.

Now it is perfectly true that men's views of what is desirable depend upon their characters; and that the innate proclivities to which we give that name are not touched by any amount of instruction. But it does not follow that even mere intellectual education may not, to an indefinite extent, modify the practical manifestation of the characters of men in their actions, by supplying them with motives unknown to the ignorant. A pleasure-loving character will have pleasure of some sort; but, if you give him the choice, he may prefer pleasures which do not degrade him to those which do. And this choice is offered to every man, who possesses in literary or artistic culture a never-failing source of pleasures, which are neither withered by age, nor staled by custom, nor embittered in the recollection by the pangs of self-reproach.

If the Institution opened to-day fulfils the intention of its founder, the picked intelligences among all classes of the population of this district will pass through it. No child born in Birmingham, henceforward, if he have the capacity to profit by the opportunities offered to him, first in the primary and other schools, and afterwards in the Scientific College, need fail to obtain, not merely

the instruction, but the culture most appropriate to the conditions of his life.

Within these walls, the future employer and the future artisan may sojourn together for a while, and carry, through all their lives, the stamp of the influences then brought to bear upon them. Hence, it is not beside the mark to remind you, that the prosperity of industry depends not merely upon the improvement of manufacturing processes, not merely upon the ennobling of the individual character, but upon a third condition, namely, a clear understanding of the conditions of social life, on the part of both the capitalist and the operative, and their argument upon common principles of social action. They must learn that social phenomena are as much the expression of natural laws as any others; that no social arrangements can be permanent unless they harmonise with the requirements of social statics and dynamics; and that, in the nature of things, there is an arbiter whose decisions execute themselves.

But this knowledge is only to be obtained by the application of the methods of investigation adopted in physical researches to the investigation of the phenomena of society. Hence, I confess, I should like to see one addition made to the excellent scheme of education propounded for the College, in the shape of provision for the teaching of Sociology. For though we are all agreed that party politics are to have no place in the instruction of the College; yet in this country, practically governed as it is now by universal suffrage, every man who does his duty must exercise political functions. And, if the evils which are inseparable from the good of political liberty are to be checked, if the perpetual oscillation of nations between anarchy and despotism is to be replaced by the steady march of self-restraining freedom; it will be because men will gradu-

ally bring themselves to deal with political, as they now deal with scientific questions; to be as ashamed of undue haste and partisan prejudice in the one case as in the other; and to believe that the machinery of society is at least as delicate as that of a spinning-jenny, and as little likely to be improved by the meddling of those who have not taken the trouble to master the principles of its action.

In conclusion, I am sure that I make myself the mouthpiece of all present in offering to the venerable founder of the Institution, which now commences its beneficent career, our congratulations on the completion of his work; and in expressing the conviction, that the remotest posterity will point to it as a crucial instance of the wisdom which natural piety leads all men to ascribe to their ancestors.

A LIBERAL EDUCATION ¹

SUPPOSE it were perfectly certain that the life and fortune of every one of us would, one day or other, depend upon his winning or losing a game of chess. Don't you think that we should all consider it to be a primary duty to learn at least the names and the moves of the pieces; to have a notion of a gambit, and a keen eye for all the means of giving and getting out of check? Do you not think that we should look with a disapprobation amounting to scorn, upon the father who allowed his son, or

¹ This definition is taken from one of Huxley's early addresses, delivered to the South London Working Men's College, in 1868, entitled *A Liberal Education: and where to find it*. The whole address was published in *Macmillan's Magazine*, in *Lay Sermons*, and in *Science and Education, Collected Essays*, III: 76-110. The address commences with a review of the reasons for the growing interest in popular education and of its supposed aims. Huxley then gives his view of education as a very practical preparation for the business of living. The main part of the essay is devoted to a criticism of the whole English educational system, the system that Huxley later helped to improve by his work with the School Board.

Huxley's ideas about the value of science in education brought him into a conflict more apparent than real with the educational ideas of Matthew Arnold. A careful comparison of Huxley's two addresses, *A Liberal Education and Science and Art*, with Arnold's *Literature and Science (Discourses in America, 1885)*, will show that they were in closer agreement than they are usually credited with being. Leonard Huxley seems to be defending his father against the popular misapprehension of Arnold's views in the following comment upon this address: "This is not a brief for science to the exclusion of other teaching; no essay has insisted more strenuously on the evils of a one-sided education, whether it be classical or scientific; but it urged the necessity for a strong tincture of science and her method, if the modern conception of the world, created by the spread of natural knowl-

the state which allowed its members, to grow up without knowing a pawn from a knight?

Yet it is a very plain and elementary truth, that the life, the fortune, and the happiness of every one of us, and, more or less, of those who are connected with us, do depend upon our knowing something of the rules of a game infinitely more difficult and complicated than chess. It is a game which has been played for untold ages, every man and woman of us being one of the two players in a game of his or her own. The chess-board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of Nature. The player on the other side is hidden from us. We know that his play is always fair, just, and patient. But also we know, to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance. To the man who plays well, the highest stakes are paid, with that sort of overflowing generosity with which the strong shows delight in strength. And one who plays ill is checkmated — without haste, but without remorse.²

edge, is to be fairly understood. If culture is the 'criticism of life,' it is fallacious if deprived of knowledge of the most important factor which has transformed the medieval into the modern spirit." *Life and Letters*, I:320. It is perhaps unnecessary to add that Arnold would no more have excluded knowledge of either the results or the methods of modern science from a liberal education than Huxley would have excluded knowledge of literature and languages.

² This idea is impressively stated in the preface to *Evolution and Ethics, Collected Essays*, IX:viii-ix. "The motive of the drama of human life is the necessity, laid upon every man who comes into the world, of discovering the mean between self-assertion and self-restraint suited to his character and his circumstances. And the eternally tragic aspect of the drama lies in this: that the problem set before us is one the elements of which can be but imperfectly known, and of which even an approximately right solution rarely presents itself, until that stern critic, aged experience, has been furnished with ample justification for venting his sarcastic humour upon the irreparable blunders we have already made."

My metaphor will remind some of you of the famous picture in which Retzsch has depicted Satan playing at chess with man for his soul. Substitute for the mocking fiend in that picture, a calm, strong angel who is playing for love, as we say, and would rather lose than win — and I should accept it as an image of human life.

X Well, what I mean by Education is learning the rules of this mighty game. In other words, education is the instruction of the intellect in the laws of Nature, under which name I include not merely things and their forces, but men and their ways; and the fashioning of the affections and of the will into an earnest and loving desire to move in harmony with those laws. For me education means neither more nor less than this. Anything which professes to call itself education must be tried by this standard, and if it fails to stand the test, I will not call it education, whatever may be the force of authority, or of numbers, upon the other side.

X X | It is important to remember that, in strictness, there is no such thing as an uneducated man. Take an extreme case. Suppose that an adult man, in the full vigour of his faculties, could be suddenly placed in the world, as Adam is said to have been, and then left to do as he best might. How long would he be left uneducated? Not five minutes. Nature would begin to teach him, through the eye, the ear, the touch, the properties of objects. Pain and pleasure would be at his elbow telling him to do this and avoid that; and by slow degrees the man would receive an education, which, if narrow, would be thorough, real, and adequate to his circumstances, though there would be no extras and very few accomplishments.

X X X | And if to this solitary man entered a second Adam, or better still, an Eve, a new and greater world, that of social and moral phenomena, would be revealed. Joys

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and woes, compared with which all others might seem but faint shadows, would spring from the new relations. Happiness and sorrow would take the place of the coarser monitors, pleasure and pain; but conduct would still be shaped by the observation of the natural consequences of actions; or, in other words, by the laws of the nature of man.

To every one of us the world was once as fresh and new as to Adam. And then, long before we were susceptible of any other mode of instruction, Nature took us in hand, and every minute of waking life brought its educational influence, shaping our actions into rough accordance with Nature's laws, so that we might not be ended untimely by too gross disobedience. Nor should I speak of this process of education as past for any one, be he as old as he may. For every man the world is as fresh as it was at the first day, and as full of untold novelties for him who has the eyes to see them. And Nature is still continuing her patient education of us in that great university, the universe, of which we are all members — Nature having no Test-Acts.³

Those who take honours in Nature's university, who learn the laws which govern men and things and obey them, are the really great and successful men in this world. The great mass of mankind are the "Poll,"⁴ who pick up just enough to get through without much discredit. Those who won't learn at all are plucked; and then you can't come up again. Nature's pluck means extermination.

³ The Test Acts excluded from public office in England and Scotland all persons who did not profess the established religion. Similar religious tests were required in English universities until 1871.

⁴ At the University of Cambridge the "pass-degree," without honours, is called the "poll-degree" and the term "poll" is said to come from *οἱ πολλοί*, "the many, the common people."

Thus the question of compulsory education is settled so far as Nature is concerned. Her bill on that question was framed and passed long ago. But, like all compulsory legislation, that of Nature is harsh and wasteful in its operation. Ignorance is visited as sharply as wilful disobedience — incapacity meets with the same punishment as crime. Nature's discipline is not even a word and a blow, and the blow first; but the blow without the word. It is left to you to find out why your ears are boxed.

The object of what we commonly call education — that education in which man intervenes and which I shall distinguish as artificial education — is to make good these defects in Nature's methods; to prepare the child to receive Nature's education, neither incapably nor ignorantly, nor with wilful disobedience; and to understand the preliminary symptoms of her displeasure, without waiting for the box on the ear. In short, all artificial education ought to be an anticipation of natural education. And a liberal education is an artificial education, which has not only prepared a man to escape the great evils of disobedience to natural laws, but has trained him to appreciate and to seize upon the rewards, which Nature scatters with as free a hand as her penalties.

That man, I think, has had a liberal education, who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great and fundamental truths of Nature and of the laws of her operations; one who, no stunted ascetic, is

full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of Nature or of art, to hate all vileness, and to respect others as himself.

Such an one and no other, I conceive, has had a liberal education; for he is, as completely as a man can be, in harmony with Nature. He will make the best of her, and she of him. They will get on together rarely; she as his ever beneficent mother; he as her mouth-piece, her conscious self, her minister and interpreter.

* For this part of education in Huntley must rely not on science but on the humanities (literature, philosophy, history) as he himself would admit or rather assert, and even more perhaps (as he would certainly not admit) upon religion. Huntley, who is very much of a moralist, is really living upon the accumulated capital of the Christian tradition.

Can the teaching of the humanist Huntley has some sensible idea dividing all subjects into the intellectual and the aesthetic (addressed to the feelings), he recognizes that

are addressed to both and advocat
a due emphasis on intellectual
content. Also he believes in the value
of history and of the historical
rather than predominantly linguistic
ON SCIENCE AND ART IN RELATION
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WHEN a man is honored by such a request as that which reached me from the authorities of your institution some time ago, I think the first thing that occurs to him is that which occurred to those who were bidden to the feast in the Gospel — to begin to make an excuse; and probably all the excuses suggested on that famous occasion crop up in his mind after the other, including his "having married a wife," as reasons for not doing what he is asked to do. But, in my own case, and on this particular occasion, there were other difficulties of a sort peculiar to the time, and more or less personal to myself; because I felt that, if I came amongst you, I should be expected, and, indeed, morally compelled, to speak upon the subject of Scientific Education. And then there arose in my mind the recollection of a fact, which probably no one here but myself remembers; namely, that some fourteen years ago I was the guest of a citizen of yours, who bears the honoured name of Rathbone, at a very charming and pleasant dinner given by the Philomathic Society; and I there and then, and

¹ This address was delivered before the members of the Liverpool Institute, 1882. It appears in *Science and Education, Collected Essays*, III:160-188. As Huxley says, he had spoken on a similar subject at Liverpool in 1869, and he sums up the main points of that speech in the beginning of this one. The notes of this after-dinner speech were published in *Macmillan's Magazine* and in *Science and Education* pp. 111-133.

in this very city, made a speech upon the topic of Scientific Education. Under these circumstances, you see, one runs two dangers—the first, of repeating one's self, although I may fairly hope that everybody has forgotten the fact I have just now mentioned, except myself; and the second, and even greater difficulty, is the danger of saying something different from what one said before, because then, however forgotten your previous speech may be, somebody finds out its existence, and there goes on that process so hateful to members of Parliament, which may be denoted by the term "Hansardisation."² Under these circumstances, I came to the conclusion that the best thing I could do was to take the bull by the horns, and to "Hansardise" myself—to put before you, in the briefest possible way, the three or four propositions which I endeavoured to support on the occasion of the speech to which I have referred; and then to ask myself, supposing you were asking me, whether I had anything to retract, or to modify, in them, in virtue of the increased experience, and, let us charitably hope, the increased wisdom of an added fourteen years.

Now, the points to which I directed particular attention on that occasion were these: in the first place, that instruction in physical science supplies information of a character of especial value, both in a practical and a speculative point of view—information which cannot be obtained otherwise; and, in the second place, that, as educational discipline, it supplies, in a better form than any other study can supply, exercise in a special form of logic, and a peculiar method of testing the validity of our processes of inquiry. I said further, that, even at that time, a great and increasing attention was

² A comparison of a man's record. Luke Hansard (1752-1828) was the official printer of British Parliamentary Records.

being paid to physical science in our schools and colleges, and that, most assuredly, such attention must go on growing and increasing, until education in these matters occupied a very much larger share of the time which is given to teaching and training, than had been the case heretofore. And I threw all the strength of argumentation of which I was possessed into the support of these propositions. But I venture to remind you, also, of some other words I used at that time, and which I ask permission to read to you. They were these: "There are other forms of culture besides physical science, and I should be profoundly sorry to see the fact forgotten, or even to observe a tendency to starve or cripple literary or æsthetic culture for the sake of science. Such a narrow view of the nature of education has nothing to do with my firm conclusion that a complete and thorough scientific culture ought to be introduced into all schools."

I say I desire, in commenting upon these various points, and judging them as fairly as I can by the light of increased experience, to particularly emphasise this last, because I am told, although I assuredly do not know it of my own knowledge — though I think if the fact were so I ought to know it, being tolerably well acquainted with that which goes on in the scientific world, and which has gone on there for the last thirty years — that there is a kind of sect, or horde, of scientific Goths and Vandals, who think it would be proper and desirable to sweep away all other forms of culture and instruction, except those in physical science, and to make them the universal and exclusive, or, at any rate, the dominant training of the human mind of the future generation. This is not my view — I do not believe that it is anybody's view — but it is attributed to those who, like myself, advocate scientific education. I therefore

dwell strongly upon the point, and I beg you to believe that the words I have just now read were by no means intended by me as a sop to the Cerberus³ of culture. I have not been in the habit of offering sops to any kind of Cerberus; but it was an expression of profound conviction on my own part — a conviction forced upon me not only by my mental constitution, but by the lessons of what is now becoming a somewhat long experience of varied conditions of life.

I am not about to trouble you with my autobiography; the omens are hardly favourable, at present, for work of that kind. But I should like if I may do so without appearing, what I earnestly desire not to be, egotistical — I should like to make it clear to you, that such notions as these, which are sometimes attributed to me, are, as I have said, inconsistent with my mental constitution, and still more inconsistent with the upshot of the teaching of my experience. For I can certainly claim for myself that sort of mental temperament which can say that nothing human comes amiss to it. I have never yet met with any branch of human knowledge which I have found unattractive⁴ — which it would not have been pleasant to me to follow, so far as I could go; and I have yet to meet with any form of art in which it has not been possible for me to take as acute a pleasure as, I believe, it is possible for men to take.

And with respect to the circumstances of life, it so happens that it has been my fate to know many lands and many climates, and to be familiar, by personal ex-

³ In his lines *Of Poetry* Jonathan Swift wrote of the king's ministers when they descended to Hades:

"To Cerberus they give a sop,
His triple-barking mouth to stop."

⁴ An allusion to Terence's celebrated line, *humani nihil a me alienum puto*, "I consider nothing human foreign to me."

perience, with almost every form of society, from the uncivilised savage of Papua and Australia and the civilised savages of the slums and dens of the poverty-stricken parts of great cities, to those who, perhaps, are occasionally the somewhat over-civilised members of our upper ten thousand. And I have never found, in any of these conditions of life, a deficiency of something which was attractive. Savagery has its pleasures, I assure you, as well as civilisation, and I may even venture to confess — if you will not let a whisper of the matter get back to London, where I am known — I am even fain to confess, that sometimes in the din and throng of what is called “a brilliant reception” the vision crosses my mind of waking up from the soft plank which has afforded me satisfactory sleep during the hours of the night, in the bright dawn of a tropical morning, when my comrades were yet asleep, when every sound was hushed, except the little lap-lap of the ripples against the sides of the boat, and the distant twitter of the sea-bird on the reef. And when that vision crosses my mind, I am free to confess I desire to be back in the boat again. So that, if I share with those strange persons to whose asserted, but still hypothetical existence I have referred, the want of appreciation of forms of culture other than the pursuit of physical science, all I can say is, that it is, in spite of my constitution, and in spite of my experience, that such should be my fate.

But now let me turn to another point, or rather to two other points, with which I propose to occupy myself. How far does the experience of the last fourteen years justify the estimate which I ventured to put forward of the value of scientific culture, and of the share — the increasing share — which it must take in ordinary education? Happily, in respect to that matter, you need not rely upon my testimony. In the last half-

dozen numbers of the "Journal of Education," you will find a series of very interesting and remarkable papers, by gentlemen who are practically engaged in the business of education in our great public and other schools, telling us what is doing in these schools, and what is their experience of the results of scientific education there, so far as it has gone. I am not going to trouble you with an abstract of those papers, which are well worth your study in their fullness and completeness, but I have copied out one remarkable passage, because it seems to me so entirely to bear out what I have formerly ventured to say about the value of science, both as to its subject-matter and as to the discipline which the learning of science involves. It is from a paper by Mr. Worthington — one of the masters at Clifton,⁵ the reputation of which school you know well, and at the head of which is an old friend of mine, the Rev. Mr. Wilson — to whom much credit is due for being one of the first, as I can say from my own knowledge, to take up this question and work it into practical shape. What Mr. Worthington says is this:

"It is not easy to exaggerate the importance of the information imparted by certain branches of science; it modifies the whole criticism of life made in maturer years. The study has often, on a mass of boys, a certain influence which, I think, was hardly anticipated, and to which a good deal of value must be attached — an influence as much moral as intellectual, which is shown in the increased and increasing respect for precision of statement, and for that form of veracity which consists in the acknowledgment of difficulties. It produces a real effect to find that Nature cannot be imposed upon, and the attention given to experimental lectures, at first su-

⁵ Clifton College is one of the principal modern English public schools. It is located near Bristol.

perfidious and curious only, soon becomes minute, serious, and practical."

Ladies and gentlemen, I could not have chosen better words to express — in fact, I have, in other words, expressed the same conviction in former days — what the influence of scientific teaching, if properly carried out, must be.

But now comes the question of properly carrying it out, because, when I hear the value of school teaching in physical science, disputed, my first impulse is to ask the disputer, "What have you known about it?" and he generally tells me some lamentable case of failure. Then I ask, "What are the circumstances of the case, and how was the teaching carried out?" I remember, some few years ago, hearing of the head master of a large school, who had expressed great dissatisfaction with the adoption of the teaching of physical science — and that after experiment. But the experiment consisted in this — in asking one of the junior masters in the school to get up science, in order to teach it; and the young gentleman went away for a year and got up science and taught it. Well, I have no doubt that the result was as disappointing as the head master said it was, and I have no doubt that it ought to have been as disappointing, and far more disappointing too; for, if this kind of instruction is to be of any good at all, if it is not to be less than no good, if it is to take the place of that which is already of some good, then there are several points which must be attended to.

And the first of these is the proper selection of topics, the second is practical teaching, the third is practical teachers, and the fourth is sufficiency of time. If these four points are not carefully attended to by anybody who undertakes the teaching of physical science in

schools, my advice to him is, to let it alone. I will not dwell at any length upon the first point, because there is a general concensus of opinion as to the nature of the topics which should be chosen. The second point — practical teaching — is one of great importance, because it requires more capital to set it a-going, demands more time, and, last, but by no means least, it requires much more personal exertion and trouble on the part of those professing to teach, than is the case with other kinds of instruction.

When I accepted the invitation to be here this evening, your secretary was good enough to send me the addresses which have been given by distinguished persons who have previously occupied this chair. I don't know whether he had a malicious desire to alarm me; but, however that may be, I read the addresses, and derived the greatest pleasure and profit from some of them, and from none more than from the one given by the great historian, Mr. Freeman, which delighted me most of all; and, if I had not been ashamed of plagiarising, and if I had not been sure of being found out, I should have been glad to have copied very much of what Mr. Freeman said, simply putting in the word science for history. There was one notable passage: "The difference between good and bad teaching mainly consists in this, whether the words used are really clothed with a meaning or not." And Mr. Freeman gives a remarkable example of this. He says, when a little girl was asked where Turkey was, she answered that it was in the yard with the other fowls, and that showed she had a definite idea connected with the word Turkey, and was, so far, worthy of praise. I quite agree with that commendation; but what a curious thing it is that one should now find it necessary to urge that this is the be-all and end-all of scientific instruction — the *sine quâ non*.

the absolutely necessary condition,—and yet that it was insisted upon more than two hundred years ago by one of the greatest men science ever possessed in this country, William Harvey.⁶ Harvey wrote, or at least published, only two small books, one of which is the well-known treatise on the circulation of the blood. The other, the “*Exercitationes de Generatione*,” is less known, but not less remarkable. And not the least valuable part of it is the preface, in which there occurs this passage: “Those who, reading the words of authors, do not form sensible images of the things referred to, obtain no true ideas, but conceive false imaginations and inane phantasms.” You see, William Harvey’s words are just the same in substance as those of Mr. Freeman, only they happen to be rather more than two centuries older. So that what I am now saying has its application elsewhere than in science; but assuredly in science the condition of knowing, of your own knowledge, things which you talk about, is absolutely imperative.

I remember, in my youth, there were detestable books which ought to have been burned by the hands of the common hangman, for they contained questions and answers to be learned by heart, of this sort, “What is a horse? The horse is termed *Equus caballus*; belongs to the class Mammalia; order, Pachydermata; family, Solidungula.” Was any human being wiser for learning that magic formula? Was he not more foolish, inasmuch as he was deluded into taking words for knowledge? It is that kind of teaching that one wants to get rid of, and banished out of science. Make it as little as you like, but, unless that which is taught is based on actual observation and familiarity with facts, it is better left alone.

There are a great many people who imagine that ele-

⁶ See *On Improving Natural Knowledge*, p. 22.

mentary teaching might be properly carried out by teachers provided with only elementary knowledge. Let me assure you that that is the profoundest mistake in the world. There is nothing so difficult to do as to write a good elementary book, and there is nobody so hard to teach properly and well as people who know nothing about a subject, and I will tell you why. If I address an audience of persons who are occupied in the same line of work as myself, I can assume that they know a vast deal, and that they can find out the blunders I make. If they don't it is their fault and not mine; but when I appear before a body of people who know nothing about the matter, who take for gospel whatever I say, surely it becomes needful that I consider what I say, make sure that it will bear examination, and that I do not impose upon the credulity of those who have faith in me. In the second place, it involves that difficult process of knowing what you know so well that you can talk about it as you can talk about your ordinary business. A man can always talk about his own business. He can always make it plain; but, if his knowledge is hearsay, he is afraid to go beyond what he has recollected, and put it before those that are ignorant in such a shape that they shall comprehend it. That is why, to be a good elementary teacher, to teach the elements of any subject, requires most careful consideration, if you are a master of the subject; and, if you are not a master of it, it is needful you should familiarise yourself with so much as you are called upon to teach — soak yourself in it, so to speak — until you know it as part of your daily life and daily knowledge, and then you will be able to teach anybody. That is what I mean by practical teachers, and, although the deficiency of such teachers is being remedied to a large extent, I think it is one which has long existed, and

which has existed from no fault of those who undertook to teach, but because, until the last score of years, it absolutely was not possible for any one in a great many branches of science, whatever his desire might be, to get instruction which would enable him to be a good teacher of elementary things. All that is being rapidly altered, and I hope it will soon become a thing of the past.

The last point I have referred to is the question of the sufficiency of time. And here comes the rub. The teaching of science needs time, as any other subject; but it needs more time proportionally than other subjects, for the amount of work obviously done, if the teaching is to be, as I have said, practical. Work done in a laboratory involves a good deal of expenditure of time without always an obvious result, because we do not see anything of that quiet process of soaking the facts into the mind, which takes place through the organs of the senses. On this ground there must be ample time given to science teaching. What that amount of time should be is a point which I need not discuss now; in fact, it is a point which cannot be settled until one has made up one's mind about various other questions.

All, then, that I have to ask for, on behalf of the scientific people, if I may venture to speak for more than myself, is that you should put scientific teaching into what statesmen call the condition of "the most favoured nation"; that is to say, that it shall have as large a share of the time given to education as any other principal subject. You may say that that is a very vague statement, because the value of the allotment of time, under those circumstances, depends upon the number of principal subjects. It is x the time, and an unknown quantity of principal subjects dividing that, and science taking shares with the rest. That shows

that we cannot deal with this question fully until we have made up our minds as to what the principal subjects of education ought to be.

I know quite well that launching myself into this discussion is a very dangerous operation; that it is a very large subject, and one which is difficult to deal with, however much I may trespass upon your patience in the time allotted to me. But the discussion is so fundamental, it is so completely impossible to make up one's mind on these matters until one has settled the question, that I will even venture to make the experiment. A great lawyer-statesman and philosopher of a former age — I mean Francis Bacon⁷ — said that truth came out of error much more rapidly than it came out of confusion. There is a wonderful truth in that saying. Next to being right in this world, the best of all things is to be clearly and definitely wrong, because you will come out somewhere. If you go buzzing about between right and wrong, vibrating and fluctuating, you come out nowhere; but if you are absolutely and thoroughly and persistently wrong, you must, some of these days, have the extreme good fortune of knocking your head against a fact, and that sets you all straight again. So I will not trouble myself as to whether I may be right or wrong in what I am about to say, but at any rate I hope to be clear and definite; and then you will be able to judge for yourselves whether, in following out the train of thought I have to introduce, you knock your heads against facts or not.

I take it that the whole object of education is, in the first place, to train the faculties of the young in such a manner as to give their possessors the best chance of being happy and useful in their generation; and, in the second place, to furnish them with the most important

⁷ See *On Improving Natural Knowledge*, p. 19.

portions of that immense capitalised experience of the human race which we call knowledge of various kinds. I am using the term knowledge in its widest possible sense; and the question is, what subjects to select by training and discipline, in which the object I have just defined may be best attained.

I must call your attention further to this fact, that all the subjects of our thoughts — all feelings and propositions (leaving aside our sensations as the mere materials and occasions of thinking and feeling), all our mental furniture — may be classified under one of two heads — as either within the province of the intellect, something that can be put into propositions and affirmed or denied; or as within the province of feeling, or that which, before the name was defiled, was called the æsthetic side of our nature, and which can neither be proved nor disproved, but only felt and known.

According to the classification which I have put before you, then, the subjects of all knowledge are divisible into the two groups, matters of science and matters of art; for all things with which the reasoning faculty alone is occupied, come under the province of science; and in the broadest sense, and not in the narrow and technical sense in which we are now accustomed to use the word art, all things feelable, all things which stir our emotions, come under the term of art, in the sense of the subject-matter of the æsthetic faculty. So that we are shut up to this — that the business of education is, in the first place, to provide the young with the means and the habit of observation; and, secondly, to supply the subject-matter of knowledge either in the shape of science or of art, or of both combined.

Now, it is a very remarkable fact — but it is true of most things in this world — that there is hardly anything one-sided, or of one nature; and it is not immedi-

ately obvious what of the things that interest us may be regarded as pure science, and what may be regarded as pure art. It may be that there are some peculiarly constituted persons who, before they have advanced far into the depths of geometry, find artistic beauty about it; but, taking the generality of mankind, I think it may be said that, when they begin to learn mathematics, their whole souls are absorbed in tracing the connection between the premises and the conclusion, and that to them geometry is pure science. So I think it may be said that mechanics and osteology are pure science. On the other hand, melody in music is pure art. You cannot reason about it; there is no proposition involved in it. So, again, in the pictorial art, an arabesque, or a "harmony in gray," touches none but the æsthetic faculty. But a great mathematician, and even many persons who are not great mathematicians, will tell you that they derive immense pleasure from geometrical reasonings. Everybody knows mathematicians speak of solutions and problems as "elegant," and they tell you that a certain mass of mystic symbols is "beautiful, quite lovely." Well, you do not see it. They do see it, because the intellectual process, the process of comprehending the reasons symbolised by these figures and these signs, confers upon them a sort of pleasure, such as an artist has in visual symmetry. Take a science of which I may speak with more confidence, and which is the most attractive of those I am concerned with. It is what we call morphology, which consists in tracing out the unity in variety of the infinitely diversified structures of animals and plants. I cannot give you any example of a thorough æsthetic pleasure more intensely real than a pleasure of this kind — the pleasure which arises in one's mind when a whole mass of different structures run into one harmony as the expression of a central law.

That is where the province of art overlays and embraces the province of intellect. And, if I may venture to express an opinion on such a subject, the great majority of forms of art are not in a sense what I just now defined them to be — pure art; but they derive much of their quality from simultaneous and even unconscious excitement of the intellect.

When I was a boy, I was very fond of music, and I am so now; and it so happened that I had the opportunity of hearing much good music. Among other things, I had abundant opportunities of hearing that great old master, Sebastian Bach. I remember perfectly well — though I knew nothing about music then, and, I may add, know nothing whatever about it now — the intense satisfaction and delight which I had in listening, by the hour together, to Bach's fugues. It is a pleasure which remains with me, I am glad to think; but, of late years, I have tried to find out the why and wherefore, and it has often occurred to me that the pleasure derived from musical compositions of this kind is essentially of the same nature as that which is derived from pursuits which are commonly regarded as purely intellectual. I mean, that the source of pleasure is exactly the same as in most of my problems in morphology — that you have the theme in one of the old master's works followed out in all its endless variations, always appearing and always reminding you of unity in variety. So in painting; what is called "truth to nature" is the intellectual element coming in, and truth to nature depends entirely upon the intellectual culture of the person to whom art is addressed. If you are in Australia, you may get credit for being a good artist — I mean among the natives — if you draw a kangaroo after a fashion. But, among men of higher civilisation, the intellectual knowledge we possess brings its criticism into

our appreciation of works of art, and we are obliged to satisfy it, as well as the mere sense of beauty in colour and in outline. And so, the higher the culture and information of those whom art addresses, the more exact and precise must be what we call its "truth to nature."

If we turn to literature, the same thing is true, and you find works of literature which may be said to be pure art. A little song of Shakespeare or of Goethe is pure art; it is exquisitely beautiful, although its intellectual content may be nothing. A series of pictures is made to pass before your mind by the meaning of words, and the effect is a melody of ideas. Nevertheless, the great mass of the literature we esteem is valued, not merely because of having artistic form, but because of its intellectual content; and the value is the higher the more precise, distinct, and true is that intellectual content. And, if you will let me for a moment speak of the very highest forms of literature, do we not regard them as highest simply because the more we know the truer they seem, and the more competent we are to appreciate beauty the more beautiful they are? No man ever understands Shakespeare until he is old, though the youngest may admire him, the reason being that he satisfies the artistic instinct of the youngest and harmonizes with the ripest and richest experience of the oldest.

I have said this much to draw your attention to what, in my mind, lies at the root of all this matter, and at the understanding of one another by the men of science on the one hand, and the men of literature, and history, and art, on the other. It is not a question whether one order of study or another should predominate. It is a question of what topics of education you shall select which will combine all the needful elements in such due proportion as to give the greatest amount of food, support, and encouragement to those faculties which enable

us to appreciate truth, and to profit by those sources of innocent happiness which are open to us, and at the same time, to avoid that which is bad, and coarse, and ugly, and keep clear of the multitude of pitfalls and dangers which beset those who break through the natural or moral laws.

I address myself, in this spirit, to the consideration of the question of the value of purely literary education. Is it good and sufficient, or is it insufficient and bad? Well, here I venture to say that there are literary educations and literary educations. If I am to understand by that term the education that was current in the great majority of middle-class schools, and upper schools too, in this country when I was a boy, and which consisted absolutely and almost entirely in keeping boys for eight or ten years at learning the rules of Latin and Greek grammar, construing certain Latin and Greek authors, and possibly making verses which, had they been English verses, would have been condemned as abominable doggerel, — if that is what you mean by literary education, then I say it is scandalously insufficient and almost worthless. My reason for saying so is not from the point of view of science at all, but from the point of view of literature. I say the thing professes to be literary education that is not a literary education at all. It was not literature at all that was taught, but science in a very bad form. It is quite obvious that grammar is science and not literature. The analysis of a text by the help of the rules of grammar is just as much a scientific operation as the analysis of a chemical compound by the help of the rules of chemical analysis. There is nothing that appeals to the æsthetic faculty in that operation; and I ask multitudes of men of my own age, who went through this process, whether they ever had a conception of art or literature until they obtained

it for themselves after leaving school? Then you may say, "If that is so, if the education was scientific, why cannot you be satisfied with it?" I say, because although it is a scientific training, it is of the most inadequate and inappropriate kind. If there is any good at all in scientific education it is that men should be trained, as I said before, to know things for themselves at first hand, and that they should understand every step of the reason of that which they do.

I desire to speak with the utmost respect of that science — philology — of which grammar is a part and parcel; yet everybody knows that grammar, as it is usually learned at school, affords no scientific training. It is taught just as you would teach the rules of chess or draughts. On the other hand, if I am to understand by a literary education the study of the literatures of either ancient or modern nations — but especially those of antiquity, and especially that of ancient Greece; if this literature is studied, not merely from the point of view of philological science, and its practical application to the interpretation of texts, but as an exemplification of and commentary upon the principles of art; if you look upon the literature of a people as a chapter in the development of the human mind, if you work out this in a broad spirit, and with such collateral references to morals and politics, and physical geography, and the like as are needful to make you comprehend what the meaning of ancient literature and civilisation is, — then, assuredly, it affords a splendid and noble education. But I still think it is susceptible of improvement, and that no man will ever comprehend the real secret of the difference between the ancient world and our present time, unless he has learned to see the difference which the late development of physical science has made between the thought of this day and the thought of that,

and he will never see that difference, unless he has some practical insight into some branches of physical science; and you must remember that a literary education such as that which I have just referred to, is out of the reach of those whose school life is cut short at sixteen or seventeen.

But, you will say, all this is fault-finding; let us hear what you have in the way of positive suggestion. Then I am bound to tell you that, if I could make a clean sweep of everything — I am very glad I cannot because I might, and probably should, make mistakes — but if I could make a clean sweep of everything and start afresh, I should, in the first place, secure that training of the young in reading and writing, and in the habit of attention and observation, both to that which is told them, and that which they see, which everybody agrees to. But in addition to that I should make it absolutely necessary for everybody, for a longer or shorter period, to learn to draw. Now, you may say, there are some people who cannot draw, however much they may be taught. I deny that *in toto*, because I never yet met with anybody who could not learn to write. Writing is a form of drawing; therefore if you give the same attention and trouble to drawing as you do to writing, depend upon it, there is nobody who cannot be made to draw more or less well. Do not misapprehend me. I do not say for one moment you would make an artistic draughtsman. Artists are not made; they grow. You may improve the natural faculty in that direction, but you cannot make it; but you can teach simple drawing, and you will find it an implement of learning of extreme value. I do not think its value can be exaggerated, because it gives you the means of training the young in attention and accuracy, which are the two things in which all mankind are more deficient than in any other

mental quality whatever. The whole of my life has been spent in trying to give my proper attention to things and to be accurate, and I have not succeeded as well as I could wish; and other people, I am afraid, are not much more fortunate. You cannot begin this habit too early, and I consider there is nothing of so great a value as the habit of drawing, to secure those two desirable ends.

Then we come to the subject-matter, whether scientific or æsthetic, of education, and I should naturally have no question at all about teaching the elements of physical science of the kind I have sketched, in a practical manner; but among scientific topics, using the word scientific in the broadest sense, I would also include the elements of the theory of morals and of that of political and social life, which, strangely enough, it never seems to occur to anybody to teach a child. I would have the history of our own country, and of all the influences which have been brought to bear upon it, with incidental geography, not as a mere chronicle of reigns and battles, but as a chapter in the development of the race, and the history of civilisation.

Then with respect to æsthetic knowledge and discipline, we have happily in the English language one of the most magnificent storehouses of artistic beauty and of models of literary excellence which exists in the world at the present time. I have said before, and I repeat it here, that if a man cannot get literary culture of the highest kind out of his Bible, and Chaucer, and Shakespeare, and Milton, and Hobbes, and Bishop Berkeley, to mention only a few of our illustrious writers — I say, if he cannot get it out of those writers, he cannot get it out of anything; and I would assuredly devote a very large portion of the time of every English child to the careful study of the models of English writing of such

varied and wonderful kind as we possess, and, what is still more important and still more neglected, the habit of using that language with precision, with force, and with art. I fancy we are almost the only nation in the world who seem to think that composition comes by nature. The French attend to their own language, the Germans study theirs; but Englishmen do not seem to think it is worth their while. Nor would I fail to include, in the course of study I am sketching, translations of all the best works of antiquity, or of the modern world. It is a very desirable thing to read Homer in Greek; but if you don't happen to know Greek, the next best thing we can do is to read as good a translation of it as we have recently been furnished with in prose. You won't get all you would get from the original, but you may get a great deal; and to refuse to know this great deal because you cannot get all, seems to be as sensible as for a hungry man to refuse bread because he cannot get partridge. Finally, I would add instruction in either music or painting, or, if the child should be so unhappy, as sometimes happens, as to have no faculty for either of those, and no possibility of doing anything in any artistic sense with them, then I would see what could be done with literature alone; but I would provide, in the fullest sense, for the development of the æsthetic side of the mind. In my judgment, those are all the essentials of education for an English child. With that outfit, such as it might be made in the time given to education which is within the reach of nine-tenths of the population — with that outfit, an Englishman, within the limits of English life, is fitted to go anywhere, to occupy the highest positions, to fill the highest offices of the State, and to become distinguished in practical pursuits, in science, or in art. For, if he have the opportunity to learn all those things, and

have his mind disciplined in the various directions the teaching of those topics would have necessitated, then, assuredly, he will be able to pick up, on his road through life, all the rest of the intellectual baggage he wants.

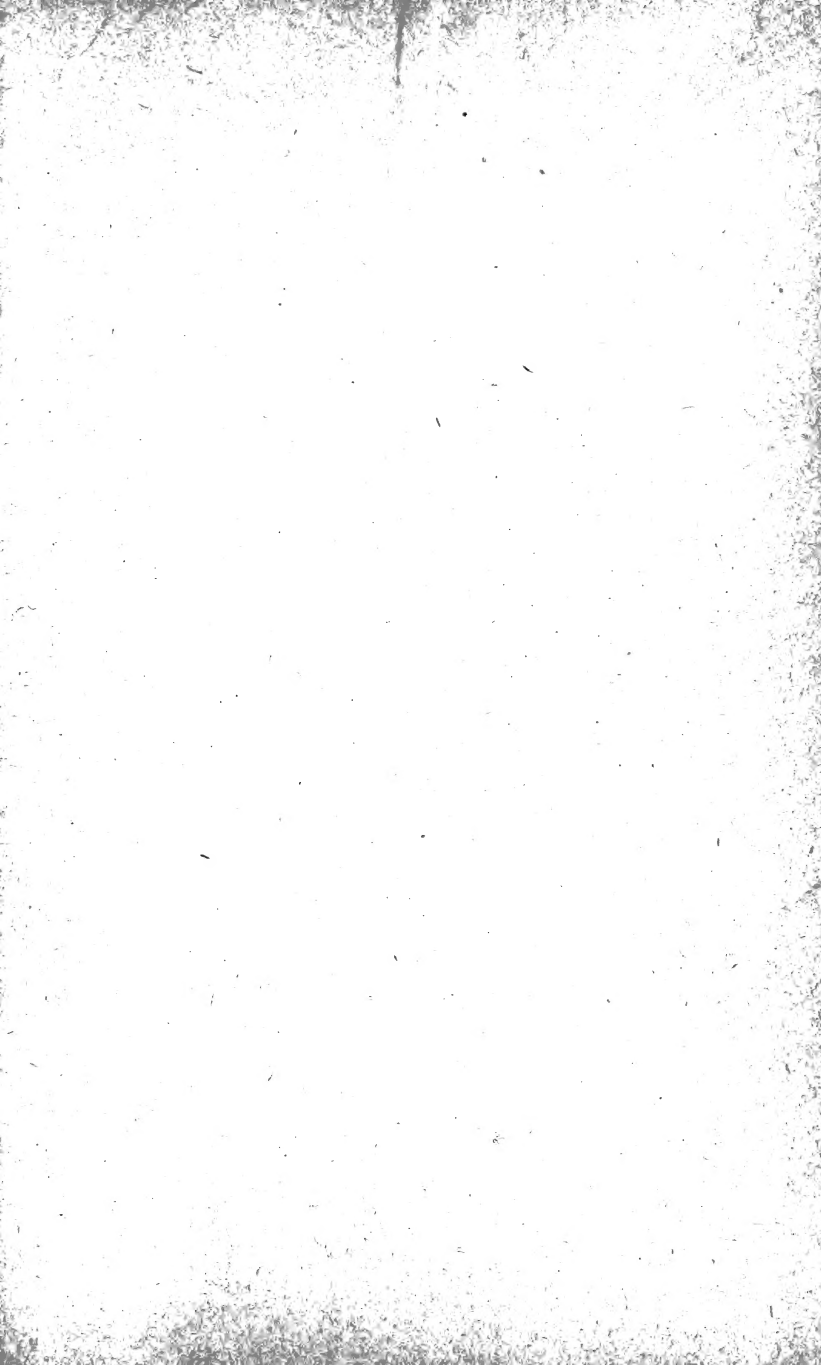
If the educational time at our disposition were sufficient there are one or two things I would add to those I have just now called the essentials; and perhaps you will be surprised to hear, though I hope you will not, that I should add, not more science, but one, or, if possible, two languages. The knowledge of some other language than one's own is, in fact, of singular intellectual value. Many of the faults and mistakes of the ancient philosophers are traceable to the fact that they knew no language but their own, and were often led into confusing the symbol with the thought which it embodied. I think it is Locke who says that one-half of the mistakes of philosophers have arisen from questions about words; and one of the safest ways of delivering yourself from the bondage of words is, to know how ideas look in words to which you are not accustomed. That is one reason for the study of language; another reason is, that it opens new fields in art and in science. Another is the practical value of such knowledge; and yet another is this, that if your languages are properly chosen, from the time of learning the additional languages you will know your own language better than ever you did. So, I say, if the time given to education permits, add Latin and German. Latin, because it is the key to nearly one-half of English and to all the Romance languages; and German, because it is the key to almost all the remainder of English, and helps you to understand a race from whom most of us have sprung, and who have a character and a literature of a fateful force in the history of the world, such as probably has been allotted to those of no other people, except the

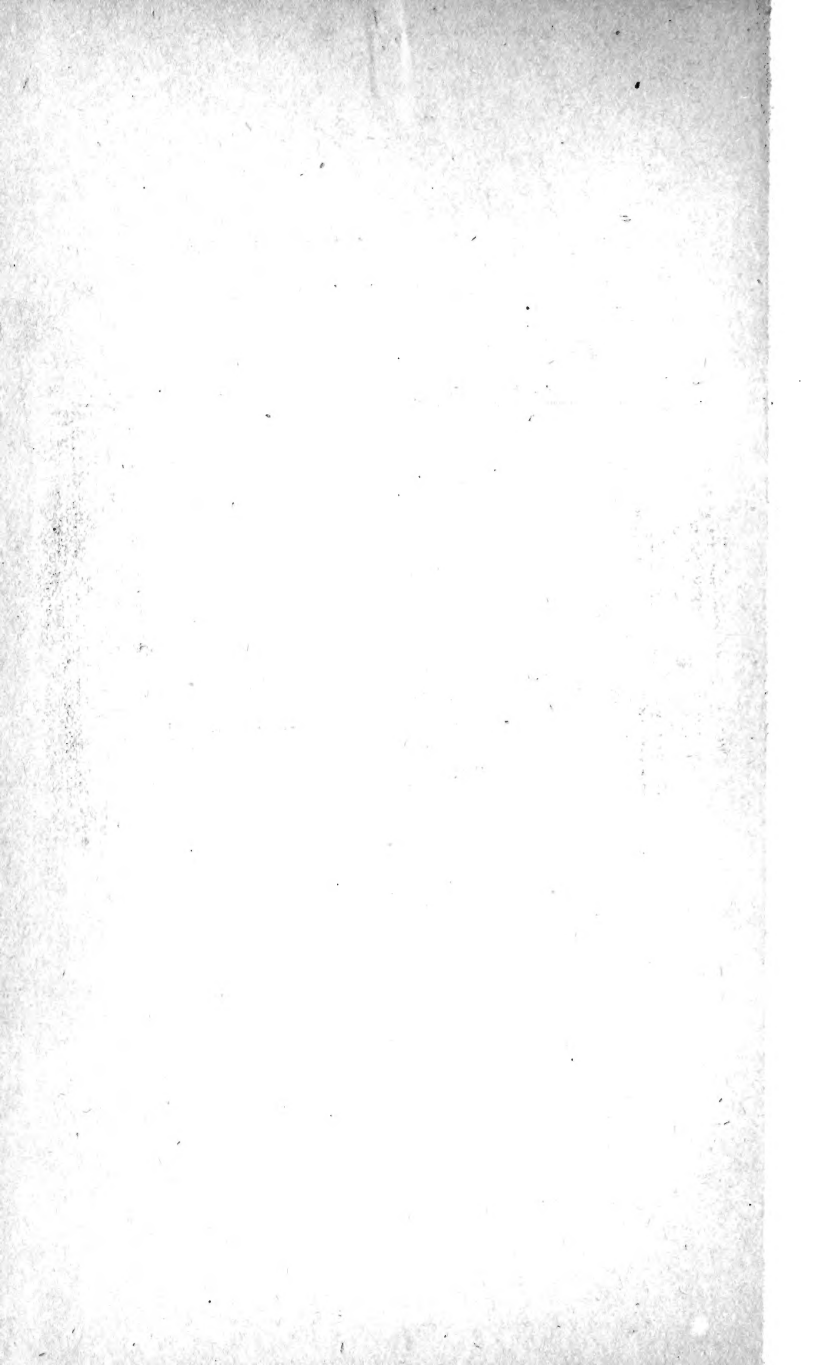
Jews, the Greeks, and ourselves. Beyond these, the essential and the eminently desirable elements of all education, let each man take up his special line — the historian devote himself to his history, the man of science to his science, the man of letters to his culture of that kind, and the artist to his special pursuit.

Bacon has prefaced some of his works with no more than this: *Franciscus Bacon sic cogitavit*; let *sic cogitavi*⁸ be the epilogue to what I have ventured to address to you to-night.

⁸ "Thus Francis Bacon thought"; "thus I thought."

THE END





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