THE

POSITIVE PHILOSOPHY

OF

AUGUSTE COMTE.

TRANSLATED

BY

HARRIET MARTINEAU

PUBLISHERS,
BELFORD, CLARKE & CO.,
CHICAGO, NEW YORK, AND SAN FRANCISCO.

CONTENTS.

INTRODUCTION.

CHAPTER I.

Account of the Aim of this Work. View of the Nature and Importance of the Positive Philosophy.

CHAPTER II.

View of the Hierarchy of the Positive Sciences.

BOOK I.—MATHEMATICS.

CHAPTER I.

Mathematics, Abstract and Concrete.

CHAPTER II.

General View of Mathematical Analysis.

CHAPTER III.

General View of Geometry.

CHAPTER IV.

Rational Mechanics.

BOOK II.—ASTRONOMY.

CHAPTER I.

General View.

CHAPTER II.

Methods of Study of Astronomy.

CHAPTER III.

Geometrical Phenomena of the Heavenly Bodies.

CHAPTER IV.

Celestial Statics.

CHAPTER V.

Celestial Dynamics.

CHAPTER VI.

Sidereal Astronomy and Cosmogony.

BOOK III.—PHYSICS.

CHAPTER I.

General View.

CHAPTER II.

Barology.

CHAPTER III.

Thermology.

CHAPTER IV.

Acoustics.

CHAPTER V.

Optics.

CHAPTER VI.

Electrology

BOOK IV.—CHEMISTRY.

CHAPTER I.

CHAPTER II.

Inorganic Chemistry.

CHAPTER III.

Doctrine of Definite Proportions.

CHAPTER IV.

The Electro-Chemical Theory.

CHAPTER V.

Organic Chemistry.

BOOK V.—BIOLOGY.

CHAPTER I.

General View of Biology.

CHAPTER II.

Anatomical Philosophy.

CHAPTER III.

Biotaxic Philosophy.

CHAPTER IV.

Organic or Vegetative Life.

CHAPTER V.

The Animal Life.

CHAPTER VI.

Intellectual and Moral or Cerebral Functions.

BOOK VI.—SOCIAL PHYSICS.

CHAPTER I.

Necessity of an Opportuneness of this New Science.

CHAPTER II.

Principal Philosophical Attempts to Constitute a Social Science.

CHAPTER III.

Characteristics of the Positive Method in its Application to Social Phenomena.

CHAPTER IV.

Relation of Sociology to the other Departments of Positive Philosophy.

CHAPTER V.

Social Statics, or Theory of the Spontaneous Order of Human Society.

CHAPTER VI.

Social Dynamics; or Theory of the Natural Progress of Human Society.

CHAPTER VII.

Preparation of the Historical Question.—First Theological Phase: Fetichism.—Beginning of the Theological and Military System.

CHAPTER VIII.

Second Phase: Polytheism.—Development of the Theological and Military System.

CHAPTER IX.

Age of Monotheism.—Modification of the Theological and Military System.

CHAPTER X.

Metaphysical State, and Critical Period of Modern Society.

CHAPTER XI.

Rise of the Elements of the Positive State.—Preparation for Social Reorganization.

CHAPTER XII.

Review of the Revolutionary Crisis.—Ascertainment of the Final Tendency of Modern Society.

CHAPTER XIII.

Final Estimate of the Positive Method.

CHAPTER XIV.

Estimate of the Results of Positive Doctrine in its Preparatory Stage.

CHAPTER XV.

Estimate of the Final Action of the Positive Philosophy.

POSITIVE PHILOSOPHY.

INTRODUCTION.

CHAPTER I.

ACCOUNT OF THE AIM OF THIS WORK.—VIEW OF THE NATURE AND IMPORTANCE OF THE POSITIVE PHILOSOPHY.

A GENERAL statement of any system of philosophy may be either a sketch of a doctrine to be established, or a summary of a doctrine already established. If greater value belongs to the last, the first is still important, as characterizing from its origin the subject to be treated. In a case like the present, where the proposed study is vast and hitherto indeterminate, it is especially important that the field of research should be marked out with all possible accuracy. For this purpose, I will glance at the considerations which have originated this work, and which will be fully elaborated in the course of it.

In order to understand the true value and character of the Positive Philosophy, we must take a brief general view of the progressive course of the human mind, regarded as a whole; for no conception can be understood otherwise than through its history.

Law of human progress.

From the study of the development of human intelligence, in all directions, and through all times, the discovery arises of a great fundamental law, to which it is necessarily subject, and which has a solid foundation of proof, both in the facts of our organization and in our historical experience. The law is this:—that each of our leading conceptions—each branch of our knowledge—passes successively through three different theoretical condititions: the Theological, or fictitious; the Metaphysical, or abstract; and the Scientific, or positive. In other words, the human mind, by its nature, employs in its progress three methods of philosophizing, the character of which is essentially different, and even radically opposed: viz., the theological method, the metaphysical, and the positive. Hence arise three philosophies, or general systems of conceptions on the aggregate of phenomena,

each of which excludes the others. The first is the necessary point of departure of the human understanding; and the third is its fixed and definite state. The second is merely a state of transition.

First Stage. In the theological state, the human mind, seeking the essential nature of beings, the first and final causes (the origin and purpose) of all effects—in short, Absolute knowledge—supposes all phenomena to be produced by the immediate action of supernatural beings.

Second Stage. In the metaphysical state, which is only a modification of the first, the mind supposes, instead of supernatural beings, abstract forces, veritable entities (that is, personified abstractions) inherent in all beings, and capable of producing all phenomena. What is called the explanation of phenomena is, in this stage, a mere reference of each to its proper entity.

Third Stage. In the final, the positive state, the mind has given over the vain search after Absolute notions, the origin and destination of the universe, and the causes of phenomena, and applies itself to the study of their laws—that is, their invariable relations of succession and resemblance. Reasoning and observation, duly combined, are the means of this knowledge. What is now understood when we speak of an explanation of facts is simply the establishment of a connection between single phenomena and some general facts, the number of which continually diminishes with the progress of science.

Ultimate point of each. The Theological system arrived at the highest perfection of which it is capable when it substituted the providential action of a single Being for the varied operations of the numerous divinities which had been before imagined. In the same way, in the last stage of the Metaphysical system, men substitute one great entity (Nature) as the cause of all phenomena, instead of the multitude of entities at first supposed. In the same way, again, the ultimate perfection of the Positive system would be (if such perfection could be hoped for) to represent all phenomena as particular aspects of a single general fact—such as Gravitation, for instance.

The importance of the working of this general law will be established hereafter. At present, it must suffice to point out some of the grounds of it.

Evidences of the law. There is no science which, having attained the positive stage, does not bear marks of having passed through the others. Some time since it was (whatever it might be) composed, as we can now perceive, of metaphysical abstractions; and, further back in the course of time, it took its form from theological conceptions. We shall have only too much occasion to see, as we proceed, that our most advanced sciences still bear very evident marks of the two earlier periods through which they have passed.

Actual.

The progress of the individual mind is not only an illustration,

but an indirect evidence of that of the general mind. The point of departure of the individual and of the race being the same, the phases of the mind of a man correspond to the epochs of the mind of the race. Now, each of us is aware, if he looks back upon his own history, that he was a theologian in his childhood, a metaphysician in his youth, and a natural philosopher in his manhood. All men who are up to their age can verify this for themselves.

Besides the observation of facts, we have theoretical reasons in support of this law.

Theoretical.

The most important of these reasons arises from the necessity that always exists for some theory to which to refer our facts, combined with the clear impossibility that, at the outset of human knowledge, men could have formed theories out of the observation of facts. All good intellects have repeated, since Bacon's time, that there can be no real knowledge but that which is based on observed facts. This is incontestable, in our present advanced stage; but, if we look back to the primitive stage of human knowledge, we shall see that it must have been otherwise then. If it is true that every theory must be based upon observed facts, it is equally true that facts can not be observed without the guidance of some theory. Without such guidance, our facts would be desultory and fruitless; we could not retain them: for the most part we could not even perceive them.

Thus, between the necessity of observing facts in order to form a theory, and having a theory in order to observe facts, the human mind would have been entangled in a vicious circle, but for the natural opening afforded by Theological conceptions. This is the fundamental reason for the theological character of the primitive philosophy. This necessity is confirmed by the perfect suitability of the theological philosophy to the earliest researches of the human mind. It is remarkable that the most inaccessible questions —those of the nature of beings, and the origin and purpose of phenomena—should be the first to occur in a primitive state, while those which are really within our reach are regarded as almost unworthy of serious study. The reason is evident enough:—that experience alone can teach us the measure of our powers; and if men had not begun by an exaggerated estimate of what they can do, they would never have done all that they are capable of. Our organization requires this. At such a period there could have been no reception of a positive philosophy, whose function is to discover the laws of phenomena, and whose leading characteristic it is to regard as interdicted to human reason those sublime mysteries which theology explains, even to their minutest details, with the most attractive facility. It is just so under a practical view of the nature of the researches with which men first occupied themselves. Such inquiries offered the powerful charm of unlimited empire over the external world—a world destined wholly for our use, and involved in every way with our existence. The theological philosophy, presenting this view, administered exactly the stimulus

necessary to incite the human mind to the irksome labor without which it could make no progress. We can now scarcely conceive of such a state of things, our reason having become sufficiently mature to enter upon laborious scientific researches, without needing any such stimulus as wrought upon the imaginations of astrologers and alchemists. We have motive enough in the hope of discovering the laws of phenomena, with a view to the confirmation or rejection of a theory. But it could not be so in the earliest days; and it is to the chimeras of astrology and alchemy that we owe the long series of observations and experiments on which our positive science is based. Kepler felt this on behalf of astronomy, and Berthollet on behalf of chemistry. Thus was a spontaneous philosophy, the theological, the only possible beginning, method, and provisional system, out of which the Positive philosophy could grow. It is easy, after this, to perceive how Metaphysical methods and doctrines must have afforded the means of transition from the one to the other.

The human understanding, slow in its advance, could not step at once from the theological into the positive philosophy. The two are so radically opposed, that an intermediate system of conceptions has been necessary to render the transition possible. It is only in doing this, that metaphysical conceptions have any utility whatever. In contemplating phenomena, men substitute for supernatural direction a corresponding entity. This entity may have been supposed to be derived from the supernatural action: but it is more easily lost sight of, leaving attention free from the facts themselves, till, at length, metaphysical agents have ceased to be anything more than the abstract names of phenomena. It is not easy to say by what other process than this our minds could have passed from supernatural considerations to natural; from the theological system to the positive.

The law of human development being thus established, let us consider what is the proper nature of the Positive Philosophy.

Character of the Positive Philosophy.

As we have seen, the first characteristic of the Positive Philosophy is that it regards all phenomena as subjected to invariable natural *Laws*. Our business is, —seeing how vain is any research into what are called *Causes*, whether first or final.—to pursue an accurate discovery of these Laws, with a view to reducing them to the smallest possible number. By speculating upon causes, we could solve no difficulty about origin and purpose. Our real business is to analyse accurately the circumstances of phenomena, and to connect them by the natural relations of succession and resemblance. The best illustration of this is in the case of the doctrine of Gravitation. We say that the general phenomena of the universe are *explained* by it, because it connects under one head the whole immense variety of astronomical facts; exhibiting the constant tendency of atoms toward each other in direct proportion to their masses, and in inverse proportion to the squares of their distance; while the general fact itself is a mere extension

of one which is perfectly familiar to us, and which we therefore say that we know;—the weight of bodies on the surface of the earth. As to what weight and attraction are, we have nothing to do with that, for it is not a matter of knowledge at all. Theologians and metaphysicians may imagine and refine about such questions; but positive philosophy rejects them. When any attempt has been made to explain them, it has ended only in saying that attraction is universal weight, and that weight is terrestrial attraction: that is, that the two orders of phenomena are identical; which is the point from which the question set out. Again, M. Fourier, in his fine series of researches on Heat, has given us all the most important and precise laws of the phenomena of heat, and many large and new truths, without once inquiring into its nature, as his predecessors had done when they disputed about calorific matter and the action of a universal ether. In treating his subject in the Positive method, he finds inexhaustible material for all his activity of research, without betaking himself to insoluble questions.

History of the Positive Philosophy.

Before ascertaining the stage which the Positive Philosophy has reached, we must bear in mind that the different kinds of our knowledge have passed through the three stages of progress at different rates, and have not therefore arrived at the same time. The rate of advance depends on the nature of the knowledge in question, so distinctly that, as we shall see hereafter, this consideration constitutes an accessary to the fundamental law of progress. Any kind of knowledge reaches the positive stage early in proportion to its generality, simplicity, and independence of other departments. Astronomical science, which is above all made up of facts that are general, simple, and independent of other sciences, arrived first; then terrestrial Physics; then Chemistry; and, at length, Physiology.

It is difficult to assign any precise date to this revolution in science. It may be said, like everything else, to have been always going on; and especially since the labors of Aristotle and the school of Alexandria; and then from the introduction of natural science into the West of Europe by the Arabs. But, if we must fix upon some marked period, to serve as a rallying point, it must be that,—about two centuries ago,—when the human mind was astir under the precepts of Bacon, the conceptions of Descartes, and the discoveries of Galileo. Then it was that the spirit of the Positive philosophy rose up in opposition to that of the superstitious and scholastic systems which had hitherto obscured the true character of all science. Since that date, the progress of the Positive philosophy, and the decline of the other two, have been so marked that no rational mind now doubts that the revolution is destined to go on to its completion,—every branch of knowledge being, sooner or later, brought within the operation of Positive philosophy. This is not yet the case. Some are still lying outside: and not till they are brought in will the Positive philosophy possess

that character of universality which is necessary to its definitive constitution.

In mentioning just now the four principal categories of phenomena,—astronomical, physical, chemical, and physiological,—there was an omission which will have been noticed. Nothing was said of Social phenomena. Though involved with the physiological, Social phenomena demand a distinct classification, both on account of their importance and of their difficulty. They are the most individual, the most complicated, the most dependent on all others; and therefore they must be the latest,—even if they had no special obstacle to encounter. This branch of science has not hitherto entered into the domain of Positive philosophy. Theological and metaphysical methods, exploded in other departments, are as yet exclusively applied, both in the way of inquiry and discussion, in all treatment of Social subjects, though the best minds are heartily weary of eternal disputes about divine right and the sovereignty of the people. This is the great, while it is evidently the only gap which has to be filled, to constitute, solid and entire, the Positive Philosophy. Now that the human mind has grasped celestial and terrestrial physics,—mechanical and chemical; organic physics, both vegetable and animal,—there remains one science, to fill up the series of sciences of observation,—Social physics. This is what men have now most need of: and this it is the principal aim of the present work to establish.

New department of Positive philosophy.

It would be absurd to pretend to offer this new science at once in a complete state. Others, less new, are in very unequal conditions of forwardness. But the same character of positivity which is impressed on all the others will be shown to belong to this. This once done, the philosophical system of the moderns will be in fact complete, as there will then be no phenomenon which does not naturally enter into some one of the five great categories. All our fundamental conceptions having become homogeneous, the Positive state will be fully established. It can never again change its character, though it will be for ever in course of development by additions of new knowledge. Having acquired the character of universality which has hitherto been the only advantage resting with the two preceding systems, it will supersede them by its natural superiority, and leave to them only an historical existence.

Social Physics.

We have stated the special aim of this work. Its secondary and general aim is this:—to review what has been effected in the Sciences, in order to show that they are not radically separate, but all branches from the same trunk. If we had confined ourselves to the first and special object of the work, we should have produced merely a study of Social physics: whereas, in introducing the second and general, we offer a study of Positive philosophy, passing in review all the positive sciences already formed.

Secondary aim of this work.

To review the philosophy of the Sciences.

The purpose of this work is not to give an account of the Natural Sciences. Besides that it would be endless, and that it would require a scientific preparation such as no one man possesses, it would be apart from our object, which is to go through a course of not Positive Science, but Positive Philosophy. We have only to consider each fundamental science in its relation to the whole positive system, and to the spirit which characterizes it; that is, with regard to its methods and its chief results.

The two aims, though distinct, are inseparable; for, on the one hand, there can be no positive philosophy without a basis of social science, without which it could not be all-comprehensive; and, on the other hand, we could not pursue Social science without having been prepared by the study of phenomena less complicated than those of society, and furnished with a knowledge of laws and anterior facts which have a bearing upon social science. Though the fundamental sciences are not all equally interesting to ordinary minds, there is no one of them that can be neglected in an inquiry like the present; and, in the eye of philosophy, all are of equal value to human welfare. Even those which appear the least interesting have their own value, either on account of the perfection of their methods, or as being the necessary basis of all the others.

Speciality.

Lest it should be supposed that our course will lead us into a wilderness of such special studies as are at present the bane of a true positive philosophy, we will briefly advert to the existing prevalence of such special pursuit. In the primitive state of human knowledge there is no regular division of intellectual labor. Every student cultivates all the sciences. As knowledge accrues, the sciences part off; and students devote themselves each to some one branch. It is owing to this division of employment, and concentration of whole minds upon a single department, that science has made so prodigious an advance in modern times; and the perfection of this division is one of the most important characteristics of the Positive philosophy. But, while admitting all the merits of this change, we can not be blind to the eminent disadvantages which arise from the limitation of minds to a particular study. It is inevitable that each should be possessed with exclusive notions, and be therefore incapable of the general superiority of ancient students, who actually owed that general superiority to the inferiority of their knowledge. We must consider whether the evil can be avoided without losing the good of the modern arrangement; for the evil is becoming urgent. We all acknowledge that the divisions established for the convenience of scientific pursuit are radically artificial; and yet there are very few who can embrace in idea the whole of any one science: each science moreover being itself only a part of a great whole. Almost every one is busy about his own particular section, without much thought about its relation to the general system of positive knowledge. We must not be blind to the evil, nor slow

in seeking a remedy. We must not forget that this is the weak side of the positive philosophy, by which it may yet be attacked, with some hope of success, by the adherents of the theological and metaphysical systems. As to the remedy, it certainly does not lie in a return to the ancient confusion of pursuits, which would be mere retrogression, if it were possible, which it is not. It lies in perfecting the division of employments itself,—in carrying it one degree higher,—in constituting one more speciality from the study of scientific generalities. Let us have a new class of students, suitably prepared, whose business it shall be to take the respective sciences as they are, determine the spirit of each, ascertain their relations and mutual connection, and reduce their respective principles to the smallest number of general principles, in conformity with the fundamental rules of the Positive Method. At the same time, let other students be prepared for their special pursuit by an education which recognises the whole scope of positive science, so as to profit by the labors of the students of generalities, and so as to correct reciprocally, under that guidance, the results obtained by each. We see some approach already to this arrangement. Once established, there would be nothing to apprehend from any extent of division of employments. When we once have a class of learned men, at the disposal of all others, whose business it shall be to connect each new discovery with the general system, we may dismiss all fear of the great whole being lost sight of in the pursuit of the details of knowledge. The organization of scientific research will then be complete; and it will henceforth have occasion only to extend its development, and not to change its character. After all, the formation of such a new class as is proposed would be merely an extension of the principle which has created all the classes we have. While science was narrow, there was only one class: as it expanded, more were instituted. With a further advance a fresh need arises, and this new class will be the result.

Proposed new class of students.

The general spirit of a course of Positive Philosophy having been thus set forth, we must now glance at the chief advantages which may be derived, on behalf of human progression, from the study of it. Of these advantages, four may be especially pointed out.

Advantages of the Positive Philosophy.

I. The study of the Positive Philosophy affords the only rational means of exhibiting the logical laws of the human mind, which have hitherto been sought by unfit methods. To explain what is meant by this, we may refer to a saying of M. de Blainville, in his work on Comparative Anatomy, that every active, and especially every living being, may be regarded under two relations—the Statical and the Dynamical; that is, under conditions or in action. It is clear that all considerations range themselves under the one or the other of these heads. Let us apply this classification to the intellectual functions.

Illustrates the Intellectual function.

If we regard these functions under their Statical aspect—that is,

if we consider the conditions under which they exist—we must determine the organic circumstances of the case, which inquiry involves it with anatomy and physiology. If we look at the Dynamic aspect, we have to study simply the exercise and results of the intellectual powers of the human race, which is neither more nor less than the general object of the Positive Philosophy. In short, looking at all scientific theories as so many great logical facts, it is only by the thorough observation of these facts that we can arrive at the knowledge of logical laws. These being the only means of knowledge of intellectual phenomena, the illusory psychology, which is the last phase of theology, is excluded. It pretends to accomplish the discovery of the laws of the human mind by contemplating it in itself; that is, by separating it from causes and effects. Such an attempt, made in defiance of the physiological study of our intellectual organs, and of the observation of rational methods of procedure, can not succeed at this time of day.

The Positive Philosophy, which has been rising since the time of Bacon, has now secured such a preponderance, that the metaphysicians themselves profess to ground their pretended science on an observation of facts. They talk of external and internal facts, and say that their business is with the latter. This is much like saying that vision is explained by luminous objects painting their images upon the retina. To this the physiologists reply that another eye would be needed to see the image. In the same manner, the mind may observe all phenomena but its own. It may be said that a man's intellect may observe his passions, the seat of the reason being somewhat apart from that of the emotions in the brain; but there can be nothing like scientific observation of the passions, except from without, as the stir of the emotions disturbs the observing faculties more or less. It is yet more out of the question to make an intellectual observation of intellectual processes. The observing and observed organ are here the same, and its action can not be pure and natural. In order to observe, your intellect must pause from activity; yet it is this very activity that you want to observe. If you can not effect the pause, you can not observe: if you do effect it, there is nothing to observe. The results of such a method are in proportion to its absurdity. After two thousand years of psychological pursuit, no one proposition is established to the satisfaction of its followers. They are divided, to this day, into a multitude of schools, still disputing about the very elements of their doctrine. This interior observation gives birth to almost as many theories as there are observers. We ask in vain for any one discovery, great or small, which has been made under this method. The psychologists have done some good in keeping up the activity of our understandings, when there was no better work for our faculties to do; and they may have added something to our stock of knowledge. If they have done so, it is by practising the Positive method—by observing the progress of the human mind

in the light of science; that is, by ceasing, for the moment, to be psychologists.

The view just given in relation to logical Science becomes yet more striking when we consider the logical Art.

The Positive Method can be judged of only in action. It can not be looked at by itself, apart from the work on which it is employed. At all events, such a contemplation would be only a dead study, which could produce nothing in the mind which loses time upon it. We may talk for ever about the method, and state it in terms very wisely, without knowing half so much about it as the man who has once put it in practice upon a single particular of actual research, even without any philosophical intention. Thus it is that psychologists, by dint of reading the precepts of Bacon and the discourses of Descartes, have mistaken their own dreams for science.

Without saying whether it will ever be possible to establish, *à priori*, a true method of investigation, independent of a philosophical study of the sciences, it is clear that the thing has never been done yet, and that we are not capable of doing it now. We can not, as yet, explain the great logical procedures, apart from their applications. If we ever do, it will remain as necessary then as now to form good intellectual habits by studying the regular application of the scientific methods which we shall have attained.

This, then, is the first great result of the Positive Philosophy—the manifestation by experiment of the laws which rule the Intellect in the investigation of truth; and, as a consequence, the knowledge of the general rules suitable for that object.

Must regenerate Education.

II. The second effect of the Positive Philosophy, an effect not less important and far more urgently wanted, will be to regenerate Education.

The best minds are agreed that our European education, still essentially theological, metaphysical, and literary, must be superseded by a Positive training, conformable to our time and needs. Even the governments of our day have shared, where they have not originated, the attempts to establish positive instruction; and this is a striking indication of the prevalent sense of what is wanted. While encouraging such endeavors to the utmost, we must not however, conceal from ourselves that everything yet done is inadequate to the object. The present exclusive specialty of our pursuits, and the consequent isolation of the sciences, spoil our teaching. If any student desires to form an idea of natural philosophy as a whole, he is compelled to go through each department as it is now taught, as if he were to be only an astronomer, or only a chemist; so that, be his intellect what it may, his training must remain very imperfect. And yet his object requires that he should obtain general positive conceptions of all the classes of natural phenomena. It is such an aggregate of conceptions, whether on a great or on a small scale, which must henceforth be the permanent basis of

all human combinations. It will constitute the mind of future generations. In order to this regeneration of our intellectual system, it is necessary that the sciences, considered as branches from one trunk, should yield us, as a whole, their chief methods and their most important results. The specialities of science can be pursued by those whose vocation lies in that direction. They are indispensable; and they are not likely to be neglected; but they can never of themselves renovate our system of Education; and, to be of their full use, they must rest upon the basis of that general instruction which is a direct result of the Positive Philosophy.

Advances sciences by combining them.

III. The same special study of scientific generalities must also aid the progress of the respective positive sciences: and this constitutes our third head of advantages.

The divisions which we establish between the sciences are, though not arbitrary, essentially artificial. The subject of our researches is one: we divide it for our convenience, in order to deal the more easily with its difficulties. But it sometimes happens—and especially with the most important doctrines of each science—that we need what we can not obtain under the present isolation of the sciences—a combination of several special points of view; and for want of this, very important problems wait for their solution much longer than they otherwise need do. To go back into the past for example: Descartes' grand conception with regard to analytical geometry is a discovery which has changed the whole aspect of mathematical science, and yielded the germ of all future progress; and it issued from the union of two sciences which had always before been separately regarded and pursued. The case of pending questions is yet more impressive; as, for instance, in Chemistry, the doctrine of Definite Proportions. Without entering upon the discussion of the fundamental principle of this theory, we may say with assurance that, in order to determine it—in order to determine whether it is a law of nature that atoms should necessarily combine in fixed numbers—it will be indispensable that the chemical point of view should be united with the physiological. The failure of the theory with regard to organic bodies indicates that the cause of this immense exception must be investigated; and such an inquiry belongs as much to physiology as to chemistry. Again, it is as yet undecided whether azote is a simple or a compound body. It was concluded by almost all chemists that azote is a simple body; the illustrious Berzilius hesitated, on purely chemical considerations; but he was also influenced by the physiological observation that animals which receive no azote in their food have as much of it in their tissues as carnivorous animals. From this we see how physiology must unite with chemistry to inform us whether azote is simple or compound, and to institute a new series of researches upon the relation between the composition of living bodies and their mode of alimentation.

Such is the advantage which, in the third place, we shall owe to

Positive philosophy—the elucidation of the respective sciences by their combination. In the fourth place

Must reorganize society.

IV. The Positive Philosophy offers the only solid basis for that Social Reorganization which must succeed the critical condition in which the most civilized nations are now living.

It can not be necessary to prove to anybody who reads this work that Ideas govern the world, or throw it into chaos; in other words, that all social mechanism rests upon Opinions. The great political and moral crisis that societies are now undergoing is shown by a rigid analysis to arise out of intellectual anarchy. While stability in fundamental maxims is the first condition of genuine social order, we are suffering under an utter disagreement which may be called universal. Till a certain number of general ideas can be acknowledged as a rallying-point of social doctrine, the nations will remain in a revolutionary state, whatever palliatives may be devised; and their institutions can be only provisional. But whenever the necessary agreement on first principles can be obtained, appropriate institutions will issue from them, without shock or resistance; for the causes of disorder will have been arrested by the mere fact of the agreement. It is in this direction that those must look who desire a natural and regular, a normal state of society.

Now, the existing disorder is abundantly accounted for by the existence, all at once, of three incompatible philosophies—the theological, the metaphysical, and the positive. Any one of these might alone secure some sort of social order; but while the three co-exist, it is impossible for us to understand one another upon any essential point whatever. If this is true, we have only to ascertain which of the philosophies must, in the nature of things, prevail; and, this ascertained, every man, whatever may have been his former views, can not but concur in its triumph. The problem once recognised, can not remain long unsolved; for all considerations whatever point to the Positive Philosophy as the one destined to prevail. It alone has been advancing during a course of centuries, throughout which the others have been declining. The fact is incontestable. Some may deplore it, but none can destroy it, nor therefore neglect it but under penalty of being betrayed by illusory speculations. This general revolution of the human mind is nearly accomplished. We have only to complete the Positive Philosophy by bringing Social phenomena within its comprehension, and afterward consolidating the whole into one body of homogeneous doctrine. The marked preference which almost all minds, from the highest to the commonest, accord to positive knowledge over vague and mystical conceptions, is a pledge of what the reception of this philosophy will be when it has acquired the only quality that it now wants—a character of due generality. When it has become complete, its supremacy will take place spontaneously, and will re-establish order throughout society. There is, at pres-

ent, no conflict but between the theological and the metaphysical philosophies They are contending for the task of reorganizing society; but it is a work too mighty for either of them. The positive philosophy has hitherto intervened only to examine both, and both are abundantly discredited by the process. It is time now to be doing something more effective, without wasting our forces in needless controversy. It is time to complete the vast intellectual operation begun by Bacon, Descartes, and Galileo, by constructing the system of general ideas which must henceforth prevail among the human race. This is the way to put an end to the revolutionary crisis which is tormenting the civilized nations of the world.

Leaving these four points of advantage, we must attend to one precautionary reflection.

No hope of reduction to a single law.

Because it is proposed to consolidate the whole of our acquired knowledge into one body of homogeneous doctrine, it must not be supposed that we are going to study this vast variety as proceeding from a single principle, and as subjected to a single law. There is something so chimerical in attempts at universal explanation by a single law, that it may be as well to secure this Work at once from any imputation of the kind, though its development will show how undeserved such an imputation would be. Our intellectual resources are too narrow, and the universe is too complex, to leave any hope that it will ever be within our power to carry scientific perfection to its last degree of simplicity. Moreover, it appears as if the value of such an attainment, supposing it possible, were greatly overrated. The only way, for instance, in which we could achieve the business, would be by connecting all natural phenomena with the most general law we know —which is that of gravitation, by which astronomical phenomena are already connected with a portion of terrestrial physics. Laplace has indicated that chemical phenomena may be regarded as simple atomic effects of the Newtonian attraction, modified by the form and mutual position of the atoms. But supposing this view proveable (which it can not be while we are without data about the constitution of bodies), the difficulty of its application would doubtless be found so great that we must still maintain the existing division between astronomy and chemistry, with the difference that we now regard as natural that division which we should then call artificial. Laplace himself presented his idea only as a philosophic device, incapable of exercising any useful influence over the progress of chemical science. Moreover, supposing this insuperable difficulty overcome, we should be no nearer to scientific unity, since we then should still have to connect the whole of physiological phenomena with the same law, which certainly would not be the least difficult part of the enterprise. Yet, all things considered, the hypothesis we have glanced at would be the most favorable to the desired unity.

The consideration of all phenomena as referable to a single ori-

gin is by no means necessary to the systematic formation of science, any more than to the realization of the great and happy consequences that we anticipate from the positive philosophy. The only necessary unity is that of Method, which is already in great part established. As for the doctrine, it need not be *one;* it is enough that it be *homogeneous*. It is, then, under the double aspect of unity of method and homogeneousness of doctrine that we shall consider the different classes of positive theories in this work. While pursuing the philosophical aim of all science, the lessening of the number of general laws requisite for the explanation of natural phenomena, we shall regard as presumptuous every attempt, in all future time, to reduce them rigorously to one.

Having thus endeavored to determine the spirit and influence of the Positive Philosophy, and to mark the goal of our labors, we have now to proceed to the exposition of the system; that is, to the determination of the universal, or encyclopædic order, which must regulate the different classes of natural phenomena, and consequently the corresponding positive sciences.

CHAPTER II.

VIEW OF THE HIERARCHY OF THE POSITIVE SCIENCES.

Failure of proposed classifications.

In proceeding to offer a Classification of the Sciences, we must leave on one side all others that have as yet been attempted. Such scales as those of Bacon and D'Alembert are constructed upon an arbitrary division of the faculties of the mind; whereas, our principal faculties are often engaged at the same time in any scientific pursuit. As for other classifications, they have failed, through one fault or another, to command assent: so that there are almost as many schemes as there are individuals to propose them. The failure has been so conspicuous, that the best minds feel a prejudice against this kind of enterprise, in any shape.

Now, what is the reason of this?—For one reason, the distribution of the sciences, having become a somewhat discredited task, has of late been undertaken chiefly by persons who have no sound knowledge of any science at all. A more important and less personal reason, however, is the want of homogeneousness in the different parts of the intellectual system,—some having successively become positive, while others remain theological or metaphysical. Among such incoherent materials, classification is of course impossible. Every attempt at a distribution has failed from this cause, without the distributor being able to see why:—without his discovering that a radical contrariety existed between the materials

he was endeavoring to combine. The fact was clear enough, if it had but been understood, that the enterprise was premature; and that it was useless to undertake it till our principal scientific conceptions should all have become positive. The preceding chapter seems to show that this indispensable condition may now be considered fulfilled: and thus the time has arrived for laying down a sound and durable system of scientific order.

We may derive encouragement from the example set by recent botanists and zoologists, whose philosophical labors have exhibited the true principle of classification; viz., that the classification must proceed from the study of the things to be classified, and must by no means be determined by *à priori* considerations. The real affinities and natural connections presented by objects being allowed to determine their order, the classification itself becomes the expression of the most general fact. And thus does the positive method apply to the question of classification itself, as well as to the objects included under it. It follows that the mutual dependence of the sciences,—a dependence resulting from that of the corresponding phenomena,—must determine the arrangement of the system of human knowledge. Before proceeding to investigate this mutual dependence, we have only to ascertain the real bounds of the classification proposed: in other words, to settle what we mean by human knowledge, as the subject of this work.

True principle of classification.

The field of human labor is either speculation or action: and thus, we are accustomed to divide our knowledge into the theoretical and the practical. It is obvious that, in this inquiry, we have to do only with the theoretical. We are not going to treat of all human notions whatever, but of those fundamental conceptions of the different orders of phenomena which furnish a solid basis to all combinations, and are not founded on any antecedent intellectual system. In such a study, speculation is our material, and not the application of it,—except where the application may happen to throw back light on its speculative origin. This is probably what Bacon meant by that First Philosophy which he declared to be an extract from the whole of Science, and which has been so differently and so strangely interpreted by his metaphysical commentators.

Boundaries of our field.

There can be no doubt that Man's study of nature must furnish the only basis of his action upon nature; for it is only by knowing the laws of phenomena, and thus being able to foresee them, that we can, in active life, set them to modify one another for our advantage. Our direct natural power over everything about us is extremely weak, and altogether disproportioned to our needs. Whenever we effect anything great, it is through a knowledge of natural laws, by which we can set one agent to work upon another, —even very weak modifying elements producing a change in the results of a large aggregate of causes. The relation of science to art may be summed up in a brief expression:

From Science comes Prevision: from Prevision comes Action.

We must not, however, fall into the error of our time, of regarding Science chiefly as a basis of Art. However great may be the services rendered to Industry by science, however true may be the saying that Knowledge is Power, we must never forget that the sciences have a higher destination still; and not only higher, but more direct—that of satisfying the craving of our understanding to know the laws of phenomena. To feel how deep and urgent this need is, we have only to consider for a moment the physiological effects of *consternation*, and to remember that the most terrible sensation we are capable of, is that which we experience when any phenomenon seems to arise in violation of the familiar laws of nature. This need of disposing facts in a comprehensible order (which is the proper object of all scientific theories) is so inherent in our organization, that if we could not satisfy it by positive conceptions, we must inevitably return to those theological and metaphysical explanations which had their origin in this very fact of human nature. It is this original tendency which acts as a preservative, in the minds of men of science, against the narrowness and incompleteness which the practical habits of our age are apt to produce. It is through this that we are able to maintain just and noble ideas of the importance and destination of the sciences; and if it were not thus, the human understanding would soon, as Condorcet has observed, come to a stand, even as to the practical applications for the sake of which higher things had been sacrificed; for, if the arts flow from science, the neglect of science must destroy the consequent arts. Some of the most important arts are derived from speculations pursued during long ages with a purely scientific intention. For instance, the ancient Greek geometers delighted themselves with beautiful speculations on Conic Sections; those speculations wrought, after a long series of generations, the renovation of astronomy; and out of this has the art of navigation attained a perfection which it never could have reached otherwise than through the speculative labors of Archimedes and Apollonius: so that, to use Condorcet's illustration, "the sailor who is preserved from shipwreck by the exact observation of the longitude, owes his life to a theory conceived two thousand years before by men of genius who had in view simply geometrical speculations."

Our business, it is clear, is with theoretical researches, letting alone their practical application altogether. Though we may conceive of a course of study which should unite the generalities of speculation and application, the time is not come for it. To say nothing of its vast extent, it would require preliminary achievements which have not yet been attempted. We must first be in possession of appropriate Special conceptions, formed according to scientific theories; and for these we have yet to wait. Meantime, an intermediate class is rising up, whose particular destination is to organize the relation of theory and practice; such as the engineers, who do not labor in the advancement of science, but who

study it in its existing state, to apply it to practical purposes. Such classes are furnishing us with the elements of a future body of doctrine on the theories of the different arts. Already, Monge, in his view of descriptive geometry, has given us a general theory of the arts of construction. But we have as yet only a few scattered instances of this nature. The time will come when out of such results, a department of Positive philosophy may arise; but it will be in a distant future. If we remember that several sciences are implicated in every important art,—that, for instance, a true theory of Agriculture requires a combination of physiological, chemical, mechanical, and even astronomical and mathematical science,—it will be evident that true theories of the arts must wait for a large and equable development of these constituent sciences.

One more preliminary remark occurs, before we finish the prescription of our limits,—the ascertainment of our field of inquiry. We must distinguish between the two classes of Natural science; —the abstract or general, which have for their object the discovery of the laws which regulate phenomena in all conceivable cases: and the concrete, particular, or descriptive, which are sometimes called Natural sciences in a restricted sense, whose function it is to apply these laws to the actual history of existing beings. The first are fundamental; and our business is with them alone, as the second are derived, and however important, not rising into the rank of our subjects of contemplation. We shall treat of physiology, but not of botany and zoology, which are derived from it. We shall treat of chemistry, but not of mineralogy, which is secondary to it.—We may say of Concrete Physics, as these secondary sciences are called, the same thing that we said of theories of the arts,—that they require a preliminary knowledge of several sciences, and an advance of those sciences not yet achieved; so that, if there were no other reason, we must leave these secondary classes alone. At a future time Concrete Physics will have made progress, according to the development of Abstract Physics, and will afford a mass of less incoherent materials than those which it now presents. At present, too few of the students of these secondary sciences appear to be even aware that a due acquaintance with the primary sciences is requisite to all successful prosecution of their own.

Abstract science.

Concrete science.

We have now considered,

First, that science being composed of speculative knowledge and of practical knowledge, we have to deal only with the first; and

Second, that theoretical knowledge, or science properly so called, being divided into general and particular, or abstract and concrete science, we have again to deal only with the first.

Being thus in possession of our proper subject, duly prescribed, we may proceed to the ascertainment of the true order of the fundamental sciences.

Difficulty of classification.

This classification of the sciences is not so easy a matter as it may appear. However natural it may be, it will always involve something, if not arbitrary, at least artificial; and in so far, it will always involve imperfection. It is impossible to fulfil, quite rigorously, the object of presenting the sciences in their natural connection, and according to their mutual dependence, so as to avoid the smallest danger of being involved in a vicious circle. It is easy to show why.

Historical and dogmatic methods.

Every science may be exhibited under two methods or procedures, the Historical and the Dogmatic. These are wholly distinct from each other, and any other method can be nothing but some combination of these two. By the first method knowledge is presented in the same order in which it was actually obtained by the human mind, together with the way in which it was obtained. By the second, the system of ideas is presented as it might be conceived of at this day, by a mind which, duly prepared and placed at the right point of view, should begin to reconstitute the science as a whole. A new science must be pursued historically, the only thing to be done being to study in chronological order the different works which have contributed to the progress of the science. But when such materials have become recast to form a general system, to meet the demand for a more natural logical order, it is because the science is too far advanced for the historical order to be practicable or suitable. The more discoveries are made, the greater becomes the labor of the historical method of study, and the more effectual the dogmatic, because the new conceptions bring forward the earlier ones in a fresh light. Thus, the education of an ancient geometer consisted simply in the study, in their due order, of the very small number of original treatises then existing on the different parts of geometry. The writings of Archimedes and Apollonius were, in fact, about all. On the contrary, a modern geometer commonly finishes his education without having read a single original work dating further back than the most recent discoveries, which can not be known by any other means. Thus the Dogmatic Method is for ever superseding the Historical, as we advance to a higher position in science. If every mind had to pass through all the stages that every predecessor in the study had gone through, it is clear that, however easy it is to learn rather than invent, it would be impossible to effect the purpose of education,—to place the student on the vantage-ground gained by the labors of all the men who have gone before. By the dogmatic method this is done, even though the living student may have only an ordinary intellect, and the dead may have been men of lofty genius. By the dogmatic method therefore must every advanced science be attained, with so much of the historical combined with it as is rendered necessary by discoveries too recent to be studied elsewhere than in their own records. The only objection to the preference of the Dogmatic method is that it does not show how the science was attained; but a moment's reflection

will show that this is the case also with the Historical method. To pursue a science historically is quite a different thing from learning the history of its progress. This last pertains to the study of human history, as we shall see when we reach the final division of this work. It is true that a science can not be completely understood without a knowledge of how it arose; and again, a dogmatic knowledge of any science is necessary to an understanding of its history; and therefore we shall notice, in treating of the fundamental sciences, the incidents of their origin, when distinct and illustrative; and we shall use their history, in a scientific sense, in our treatment of Social Physics; but the historical study, important, even essential, as it is, remains entirely distinct from the proper dogmatic study of science. These considerations, in this place, tend to define more precisely the spirit of our course of inquiry, while they more exactly determine the conditions under which we may hope to succeed in the construction of a true scale of the aggregate fundamental sciences. Great confusion would arise from any attempt to adhere strictly to historical order in our exposition of the sciences, for they have not all advanced at the same rate; and we must be for ever borrowing from each some fact to illustrate another, without regard to priority of origin. Thus, it is clear that, in the system of the sciences, astronomy must come before physics, properly so called: and yet, several branches of physics, above all, optics, are indispensable to the complete exposition of astronomy. Minor defects, if inevitable, can not invalidate a classification which, on the whole, fulfils the principal conditions of the case. They belong to what is essentially artificial in our division of intellectual labor. In the main, however, our classification agrees with the history of science; the more general and simple sciences actually occurring first and advancing best in human history, and being followed by the more complex and restricted, though all were, since the earliest times, enlarging simultaneously.

A simple mathematical illustration will precisely represent the difficulty of the question we have to resolve, while it will sum up the preliminary considerations we have just concluded.

We propose to classify the fundamental sciences. They are six, as we shall soon see. We can not make them less; and most scientific men would reckon them as more. Six objects admit of 720 different dispositions, or, in popular language, changes. Thus we have to choose the one right order (and there can be but one right) out of 720 possible ones. Very few of these have ever been proposed; yet we might venture to say that there is probably not one in favor of which some plausible reason might not be assigned; for we see the wildest divergences among the schemes which have been proposed,—the sciences which are placed by some at the head of the scale being sent by others to the further extremity. Our problem is, then, to find the one rational order, among a host of possible systems.

True principle of classification.

Now we must remember that we have to look for the principle of classification in the comparison of the different orders of phenomena, through which Science discovers the laws which are her object. What we have to determine is the real dependence of scientific studies. Now, this dependence can result only from that of the corresponding phenomena. All observable phenomena may be included within a very few natural categories, so arranged as that the study of each category may be grounded on the principal laws of the preceding, and serve as the basis of the next ensuing. This order is determined by the degree of simplicity, or, what comes to the same thing, of generality of their phenomena. Hence results their successive dependence, and the greater or lesser facility for being studied.

Generality.

Dependence.

It is clear, *à priori*, that the most simple phenomena must be the most general; for whatever is observed in the greatest number of cases is of course the most disengaged from the incidents of particular cases. We must begin then with the study of the most general or simple phenomena, going on successively to the more particular or complex. This must be the most methodical way, for this order of generality or simplicity fixes the degree of facility in the study of phenomena, while it determines the necessary connection of the sciences by the successive dependence of their phenomena. It is worthy of remark in this place that the most general and simple phenomena are the furthest removed from Man's ordinary sphere, and must thereby be studied in a calmer and more rational frame of mind than those in which he is more nearly implicated; and this constitutes a new ground for the corresponding sciences being developed more rapidly.

We have now obtained our rule. Next we proceed to our classification.

Inorganic and Organic phenomena.

We are first struck by the clear division of all natural phenomena into two classes—of inorganic and of organic bodies. The organized are evidently, in fact, more complex and less general than the inorganic, and depend upon them, instead of being depended on by them. Therefore it is that physiological study should begin with inorganic phenomena; since the organic include all the qualities belonging to them, with a special order added, viz., the vital phenomena, which belong to organization. We have not to investigate the nature of either; for the positive philosophy does not inquire into natures. Whether their natures be supposed different or the same, it is evidently necessary to separate the two studies of inorganic matter and of living bodies. Our classification will stand through any future decision as to the way in which living bodies are to be regarded; for, on any supposition, the general laws of inorganic physics must be established before we can proceed with success to the examination of a dependent class of phenomena.

Each of these great halves of natural philosophy has subdivisions. Inorganic physics must, in accordance with our rule of generality and the order of dependence of phenomena, be divided into two sections—of celestial and terrestrial phenomena. Thus we have Astronomy, geometrical and mechanical, and Terrestrial Physics. The necessity of this division is exactly the same as in the former case.

I. Inorganic.

1. Astronomy.

Astronomical phenomena are the most general, simple, and abstract of all; and therefore the study of natural philosophy must clearly begin with them. They are themselves independent, while the laws to which they are subject influence all others whatsoever. The general effects of gravitation preponderate, in all terrestrial phenomena, over all effects which may be peculiar to them, and modify the original ones. It follows that the analysis of the simplest terrestrial phenomenon, not only chemical, but even purely mechanical, presents a greater complication than the most compound astronomical phenomenon. The most difficult astronomical question involves less intricacy than the simple movement of even a solid body, when the determining circumstances are to be computed. Thus we see that we must separate these two studies, and proceed to the second only through the first, from which it is derived.

In the same manner, we find a natural division of Terrestrial Physics into two, according as we regard bodies in their mechanical or their chemical character. Hence we have Physics, properly so called, and Chemistry. Again, the second class must be studied through the first. Chemical phenomena are more complicated than mechanical, and depend upon them, without influencing them in return. Every one knows that all chemical action is first submitted to the influence of weight, heat, electricity, etc., and presents moreover something which modifies all these. Thus, while it follows Physics, it presents itself as a distinct science.

2. Physics.

3. Chemistry.

Such are the divisions of the sciences relating to inorganic matter. An analogous division arises in the other half of Natural Philosophy—the science of organized bodies.

II. Organic.

Here we find ourselves presented with two orders of phenom ena; those which relate to the individual, and those which relate to the species, especially when it is gregarious. With regard to Man, especially, this distinction is fundamental. The last order of phenomena is evidently dependent on the first, and is more complex. Hence we have two great sections in organic physics—Physiology, properly so called, and Social Physics, which is dependent on it. In all Social phenomena we perceive the working of the physiological laws of the individual; and moreover something which modifies their effects, and which belongs to the influence of individuals over each other —singularly complicated in the case of the human race by the

1. Physiology.

2. Sociology.

influence of generations on their successors. Thus it is clear that our social science must issue from that which relates to the life of the individual. On the other hand, there is no occasion to suppose, as some eminent physiologists have done, that Social Physics is only an appendage to physiology. The phenomena of the two are not identical, though they are homogeneous; and it is of high importance to hold the two sciences separate. As social conditions modify the operation of physiological laws, Social Physics must have a set of observations of its own.

It would be easy to make the divisions of the Organic half of Science correspond with those of the Inorganic, by dividing physiology into vegetable and animal, according to popular custom. But this distinction, however important in Concrete Physics (in that secondary and special class of studies before declared to be inappropriate to this work), hardly extends into those Abstract Physics with which we have to do. Vegetables and animals come alike under our notice, when our object is to learn the general laws of life—that is, to study physiology. To say nothing of the fact that the distinction grows ever fainter and more dubious with new discoveries, it bears no relation to our plan of research; and we shall therefore consider that there is only one division in the science of organized bodies.

Five Fundamental Sciences.

Thus we have before us Five fundamental Sciences in successive dependence—Astronomy, Physics, Chemistry, Physiology, and finally Social Physics. The first considers the most general, simple, abstract, and remote phenomena known to us, and those which affect all others without being affected by them. The last considers the most particular, compound, concrete phenomena, and those which are the most interesting to Man. Between these two, the degrees of speciality, of complexity, and individuality, are in regular proportion to the place of the respective sciences in the scale exhibited. This—casting out everything arbitrary—we must regard as the true filiation of the sciences; and in it we find the plan of this work.

The true filiation.

As we proceed, we shall find that the same principle which gives this order to the whole body of science arranges the parts of each science; and its soundness will therefore be freshly attested as often as it presents itself afresh. There is no refusing a principle which distributes the interior of each science after the same method with the aggregate sciences. But this is not the place in which to do more than indicate what we shall contemplate more closely hereafter. We must now rapidly review some of the leading properties of the hierarchy of science that has been disclosed.

Filiation of their parts.

Corroborations.

This gradation is in essential conformity with the order which has spontaneously taken place among the branches of natural philosophy, when pursued separately, and without any purpose of establishing such order. Such an accordance is a strong presumption

1. This classification follows the order of disclosure of sciences.

that the arrangement is natural. Again, it coincides with the actual development of natural philosophy. If no leading science can be effectually pursued otherwise than through those which precede it in the scale, it is evident that no vast development of any science could take place prior to the great astronomical discoveries to which we owe the impulse given to the whole. The progression may since have been simultaneous; but it has taken place in the order we have recognised.

2 Solves heterogeneousness.

This consideration is so important that it is difficult to understand without it the history of the human mind. The general law which governs this history, as we have already seen, can not be verified, unless we combine it with the scientific gradation just laid down: for it is according to this gradation that the different human theories have attained in succession the theological state, the metaphysical, and finally the positive. If we do not bear in mind the law which governs progression, we shall encounter insurmountable difficulties; for it is clear that the theological or metaphysical state of some fundamental theories must have temporarily coincided with the positive state of others which precede them in our established gradation, and actually have at times coincided with them; and this must involve the law itself in an obscurity which can be cleared up only by the classification we have proposed.

3 Marks relative perfection in sciences.

Again, this classification marks, with precision, the relative perfection of the different sciences, which consists in the degree of precision of knowledge, and in the relation of its different branches. It is easy to see that the more general, simple, and abstract any phenomena are, the less they depend on others, and the more precise they are in themselves, and the more clear in their relations with each other. Thus, organic phenomena are less exact and systematic than inorganic; and of these again terrestrial are less exact and systematic than those of astronomy. This fact is completely accounted for by the gradation we have laid down; and we shall see as we proceed, that the possibility of applying mathematical analysis to the study of phenomena is exactly in proportion to the rank which they hold in the scale of the whole.

Defects are in us, not in science.

There is one liability to be guarded against, which we may mention here. We must beware of confounding the degree of precision which we are able to attain in regard to any science, with the certainty of the science itself. The certainty of science, and our precision in the knowledge of it, are two very different things, which have been too often confounded; and are so still, though less than formerly. A very absurd proposition may be very precise; as if we should say, for instance, that the sum of the angles of a triangle is equal to three right angles; and a very certain proposition may be wanting in precision in our statement of it; as, for instance, when we assert that every man will die. If the different sciences offer to us a varying degree of pre-

cision, it is from no want of certainty in themselves, but of our mastery of their phenomena.

4. Effect on Education. The most interesting property of our formula of gradation is its effect on education, both general and scientific. This is its direct and unquestionable result. It will be more and more evident as we proceed, that no science can be effectually pursued without the preparation of a competent knowledge of the anterior sciences on which it depends. Physical philosophers can not understand Physics without at least a general knowledge of Astronomy; nor Chemists, without Physics and Astronomy; nor Physiologists, without Chemistry, Physics, and Astronomy; nor, above all, the students of Social philosophy, without a general knowledge of all the anterior sciences. As such conditions are, as yet, rarely fulfilled, and as no organization exists for their fulfilment, there is among us, in fact, no rational scientific education. To this may be attributed, in great part, the imperfection of even the most important sciences at this day. If the fact is so in regard to scientific education, it is no less striking in regard to general education. Our intellectual system can not be renovated till the natural sciences are studied in their proper order. Even the highest understandings are apt to associate their ideas according to the order in which they were received: and it is only an intellect here and there, in any age, which in its utmost vigor can, like Bacon, Descartes, and Leibnitz, make a clearance in their field of knowledge, so as to reconstruct from the foundation their system of ideas.

Effect on Method. Such is the operation of our great law upon scientific education through its effect on Doctrine. We can not appreciate it duly without seeing how it affects Method.

As the phenomena which are homogeneous have been classed under one science, while those which belong to other sciences are heterogeneous, it follows that the Positive Method must be constantly modified in a uniform manner in the range of the same fundamental science, and will undergo modifications, different and more and more compound, in passing from one science to another. Thus, under the scale laid down, we shall meet with it in all its varieties; which could not happen if we were to adopt a scale which should not fulfil the conditions we have admitted. This is an all-important consideration; for if, as we have already seen, we can not understand the positive method in the abstract, but only by its application, it is clear that we can have no adequate conception of it but by studying it in its varieties of application. No one science, however well chosen, could exhibit it. Though the Method is always the same, its procedure is varied. For instance, it should be Observation with regard to one kind of phenomena, and Experiment with regard to another; and different kinds of experiment, according to the case. In the same way, a general precept, derived from one fundamental science, however applicable to another, must have its spirit preserved by a reference to its origin; as in the case of

the theory of Classifications. The best idea of the Positive Method would, of course, be obtained by the study of the most primitive and exalted of the sciences, if we were confined to one; but this isolated view would give no idea of its capacity of application to others in a modified form. Each science has its own proper advantages; and without some knowledge of them all, no conception can be formed of the power of the Method.

Orderly study of sciences.

One more consideration must be briefly adverted to. It is necessary, not only to have a general knowledge of all the sciences, but to study them in their order. What can come of a study of complicated phenomena, if the student have not learned, by the contemplation of the simpler, what a Law is, what it is to Observe; what a Positive conception is; and even what a chain of reasoning is? Yet this is the way our young physiologists proceed every day—plunging into the study of living bodies, without any other preparation than a knowledge of a dead language or two, or at most a superficial acquaintance with Physics and Chemistry, acquired without any philosophical method, or reference to any true point of departure in Natural philosophy. In the same way, with regard to Social phenomena, which are yet more complicated, what can be effected but by the rectification of the intellectual instrument, through an adequate study of the range of anterior phenomena? There are many who admit this: but they do not see how to set about the work, nor understand the Method itself, for want of the preparatory study; and thus, the admission remains barren, and social theories abide in the theological or metaphysical state, in spite of the efforts of those who believe themselves positive reformers.

These, then, are the four points of view under which we have recognised the importance of a Rational and Positive Classification.

Mathematics.

It can not but have been observed, that in our enumeration of the sciences there is a prodigious omission. We have said nothing of Mathematical science. The omission was intentional; and the reason is no other than the vast importance of mathematics. This science will be the first of which we shall treat. Meantime, in order not to omit from our sketch a department so prominent, we may indicate here the general results of the study we are about to enter upon.

A department.

In the present state of our knowledge, we must regard Mathematics less as a constituent part of natural philosophy than as having been, since the time of Descartes and Newton, the true basis of the whole of natural philosophy; though it is, exactly speaking, both the one and the other. To us it is of less value for the knowledge of which it consists, substantial and valuable as that knowledge is, than as being the most powerful instrument that the human mind can employ in the investigation of the laws of natural phenomena.

A basis.

An instrument.

A double science.

In due precision, Mathematics must be divided into two great sciences, quite distinct from each other—Abstract Mathematics, or the Calculus (taking the word in its most extended sense), and Concrete Mathematics, which is composed of General Geometry and of Rational Mechanics. The Concrete part is necessarily founded on the Abstract, and it becomes in its turn the basis of all natural philosophy; all the phenomena of the universe being regarded, as far as possible, as geometrical or mechanical.

Abstract mathematics an instrument.

The Abstract portion is the only one which is purely instrumental, it being simply an immense extension of natural logic to a certain order of deductions. Geometry and mechanics must, on the contrary, be regarded as true natural sciences, founded, like all others, on observation, though, by the extreme simplicity of their phenomena, they can be systematized to much greater perfection. It is this capacity which has caused the experimental character of their first principles to be too much lost sight of. But these two physical sciences have this peculiarity, that they are now, and will be more and more, employed rather as method than as doctrine.

Concrete mathematics a science.

It needs scarcely to be pointed out that, in placing Mathematics at the head of Positive Philosophy, we are only extending the application of the principle which has governed our whole Classification. We are simply carrying back our principle to its first manifestation. Geometrical and Mechanical phenomena are the most general, the most simple, the most abstract of all,—the most irreducible to others, the most independent of them; serving, in fact, as a basis to all others. It follows that the study of them is an indispensable preliminary to that of all others. Therefore must Mathematics hold the first place in the hierarchy of the sciences, and be the point of departure of all Education, whether general or special. In an empirical way, this has hitherto been the custom,—a custom which arose from the great antiquity of mathematical science. We now see why it must be renewed on a rational foundation.

Mathematics pre-eminent in the scale.

We have now considered, in the form of a philosophical problem, the rational plan of the study of the Positive Philosophy. The order that results is this; an order which of all possible arrangements is the only one that accords with the natural manifestation of all phenomena. MATHEMATICS, ASTRONOMY, PHYSICS, CHEMISTRY, PHYSIOLOGY, SOCIAL PHYSICS.