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978-1-108-01924-8 - History of the Inductive Sciences: From the Earliest
to the Present Times, Volume 1

William Whewell

Excerpt

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A
HISTORY
OF
INDUCTIVE SCIENCES.

.....
INTRODUCTION.

VOL. I.

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“A JUST story of learning, containing the antiquities and originals of KNOWLEDGES, and their sects; their inventions, their traditions, their diverse administrations and managings; their flourishings, their oppositions, decays, depressions, oblivions, removes; with the causes and occasions of them, and all other events concerning learning, throughout all ages of the world; I may truly affirm to be wanting.

“The use and end of which work I do not so much design for curiosity, or satisfaction of those that are the lovers of learning: but chiefly for a more serious and grave purpose; which is this, in few words, that it will make learned men more wise in the use and administration of learning.”

BACON, *Advancement of Learning*, book ii.

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INTRODUCTION.

It is my purpose to write the history of some of the most important of the physical sciences, from the earliest to the most recent periods. I shall thus have to trace some of the most remarkable branches of human knowledge, from their first germ to their growth into a vast and varied assemblage of undisputed truths; from the acute, but fruitless, essays of the early Greek philosophy, to the comprehensive systems, and demonstrated generalizations, which compose such sciences as the Mechanics, Astronomy, and Chemistry, of modern times.

The completeness of historical view which belongs to such a design, consists, not in accumulating all the details of the cultivation of each science, but in marking clearly the larger features of its formation. The historian must endeavour to point out how each of the important advances was made, by which the sciences have reached their present position; and when and by whom each of the valuable truths was obtained, of which the aggregate now constitutes a costly treasure.

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Such a task, if fitly executed, must have a well-founded interest for all those who look at the existing condition of human knowledge with complacency and admiration. The present generation finds itself the heir of a vast patrimony of science; and it must needs concern us to know the steps by which these possessions were acquired, and the documents by which they are secured to us and our heirs for ever. Our species, from the time of its creation, has been travelling onwards in pursuit of truth; and now that we have reached a lofty and commanding position, with the broad light of day around us, it must be grateful to look back on the line of our past progress;—to review the journey, begun in early twilight amid primeval wilds; for a long time continued with slow advance and obscure prospects; and gradually and in later days followed along more open and lightsome paths, in a wide and fertile region. The historian of science, from early periods to the present times, may hope for favour on the score of the mere subject of his narrative, and in virtue of the curiosity which the men of the present day may naturally feel respecting the events and persons of his story.

But such a survey may possess also an interest of another kind; it may be instructive as well as agreeable; it may bring before the reader the present form and extent, the future hopes and prospects of science, as well as its past progress. The eminence on which we stand may enable us to see the land

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of promise, as well as the wilderness through which we have passed. The examination of the steps by which our ancestors acquired our intellectual estate, may make us acquainted with our expectations as well as our possessions;—may not only remind us of what we have, but may teach us how to improve and increase our store. It will be universally expected that a history of Inductive Science should point out to us a philosophical distribution of the existing body of knowledge, and afford us some indication of the most promising mode of directing our future efforts to add to its extent and completeness.

To deduce such lessons from the past history of human knowledge, was the intention which originally gave rise to the present work. Nor is this portion of the design in any measure abandoned; but its execution, if it take place, must be attempted in a separate and future treatise, *On the Philosophy of Inductive Science*. An essay of this kind may, I trust, from the progress already made in it, be laid before the public at no long interval after the present history.

Though, therefore, many of the principles and maxims of such a work will disclose themselves with more or less of distinctness in the course of the history on which we are about to enter, the systematic and complete exposition of such principles must be reserved for this other treatise. My attempts and reflections have led me to the opinion

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that justice cannot be done to the subject without such a division of it.

To this future work, then, I must refer the reader who is disposed to require, at the outset, a precise explanation of the terms which occur in my title. It is not possible, without entering into this philosophy, to explain adequately how science which is *INDUCTIVE* differs from that which is not so; or why some portions of *knowledge* may properly be selected from the general mass and termed *SCIENCE*. It will be sufficient at present to say, that the sciences of which we have here to treat, are those which are commonly known as *the Physical Sciences*; and that by *Induction* is to be understood that process of collecting general truths from the examination of particular facts, by which such sciences have been formed.

There are, however, two or three remarks, of which the application will occur so frequently, and will tend so much to give us a clearer view of some of the subjects which occur in our history, that I will state them now in a brief and general manner.

Facts and Ideas.—In the first place, then, I remark, that, to the formation of science, two things are requisite;—facts and ideas; observation of things without, and an inward effort of thought; or, in other words, sense and reason. Neither of these elements, by itself, can constitute substantial general knowledge. The impressions of sense, unconnected by some rational and speculative principle, can only

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end in a practical acquaintance with individual objects; the operations of the rational faculties, on the other hand, if allowed to go on without a constant reference to external things, can lead only to empty abstraction and barren ingenuity. Real speculative knowledge demands the combination of the two ingredients;—right reason, and facts to reason upon. It has been well said, that true knowledge is the interpretation of nature; and thus it requires both the interpreting mind, and nature for its subject; both the document, and the ingenuity to read it aright. Thus invention, acuteness, and connexion of thought, are necessary on the one hand, for the progress of philosophical knowledge; and on the other hand, the precise and steady application of these faculties to facts well known and clearly conceived. It is easy to point out instances in which science has failed to advance, in consequence of the absence of one or other of these requisites; indeed, by far the greater part of the course of the world, the history of most times and most countries, exhibits a condition thus stationary with respect to knowledge. The facts, the impressions on the senses, on which the first successful attempts at physical knowledge proceeded, were as well known long before the time when they were thus turned to account, as at that period. The motions of the stars, and the effects of weight, were familiar to man before the rise of the Greek astronomy and mechanics: but the “diviner mind” was

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still absent; the act of thought had not been exerted, by which these facts were bound together under the form of laws and principles. And even at this day, the tribes of uncivilized and half-civilized man over the whole face of the earth, have before their eyes a vast body of facts, of exactly the same nature as those with which Europe has built the stately fabric of her physical philosophy; but, in almost every other part of the earth, the process of the intellect by which these facts become science, is unknown. The scientific faculty does not work. The scattered stones are indeed there, but the builder's hand is wanting. And again, we have no lack of proof that the mere activity of thought is equally inefficient in producing real knowledge. Almost the whole of the career of the Greek schools of philosophy; of the schoolmen of Europe in the middle ages; of the Arabian and Indian philosophers; shows us that we may have extreme ingenuity and subtlety, invention and connexion, demonstration and method; and yet that out of these germs, no physical science may be developed. We may obtain, by such means, logic and metaphysics, and even geometry and algebra; but out of such materials we shall never form mechanics and optics, chemistry and physiology. How impossible is the formation of these sciences without a constant and careful reference to observation and experiment;—how rapid and prosperous may be their progress when they draw from such sources the materials on

which the mind of the philosopher employs itself;— the history of those branches of knowledge for the last three hundred years abundantly teaches us.

Accordingly, the existence of clear ideas applied to distinct facts will be discernible in the History of Science, whenever any marked advance takes place. And, in tracing the progress of the various provinces of knowledge which come under our survey, it will be important for us to see, that, at all such epochs, such a combination has occurred; that whenever any material step in general knowledge has been made,—whenever any philosophical discovery arrests our attention;—some man or men come before us, who have possessed, in an eminent degree, a clearness of the ideas which belong to the subject in question, and who have applied such ideas in a vigorous and distinct manner to ascertained facts and exact observations. We shall never proceed through any considerable range of our narrative, without having occasion to remind the reader of this reflection.

Successive steps in Science.—But there is another remark which we must also make. Such sciences as we have here to do with, are, commonly, not formed by one single act;—they are not completed by the discovery of one great principle. On the contrary, they consist in a long-continued advance; a series of changes; a repeated progress from one principle to another, different and often apparently contradictory. Now, it is important to remember

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that this contradiction is apparent only. The principles which constituted the triumph of the preceding stages of the science, may appear to be subverted and ejected by the later discoveries, but in fact they are, (so far as they were true,) taken up into the subsequent doctrines and included in them. They continue to be an essential part of the science. The earlier truths are not expelled but absorbed, not contradicted but extended; and the history of each science, which may thus appear like a succession of revolutions, is, in reality, a series of developments. In the intellectual, as in the material world,—

Omnia mutantur nil interit

Nec manet ut fuerat nec formas servat easdem,

Sed tamen ipsa eadem est.

All changes, nought is lost; the forms are changed,

And that which has been is not what it was,

Yet that which has been is.

Nothing which was done is useless or unessential, though it ceases to be conspicuous and primary.

Thus the final form of each science contains the substance of each of its preceding modifications; and all that was at any antecedent period discovered and established, ministers to the ultimate development of its proper branch of knowledge. Such previous doctrines may require to be made precise and definite, to have their superfluous and arbitrary portions expunged, to be expressed in new language, to be taken up into the body of science by various