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History of the Inductive Sciences

A central figure in Victorian science, William Whewell (1794–1866) held professorships in Mineralogy and Moral Philosophy at Trinity College, Cambridge, before becoming Master of the college in 1841. His mathematical textbooks, such as *A Treatise on Dynamics* (1823), were instrumental in bringing French analytical methods into British science. This three-volume history, first published in 1837, is one of Whewell's most famous works. Taking the 'acute, but fruitless, essays of Greek philosophy' as a starting point, it provides a history of the physical sciences that culminates with the mechanics, astronomy, and chemistry of 'modern times'. Volume 1 studies Greek physics and metaphysics, attributing their failure to a method that derived its principles from the common use of language. It surveys the state of the physical sciences in the middle ages, and deals with the rise of 'formal' astronomy – based on observation rather than calculation – as exemplified by Copernicus.

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History of the Inductive Sciences

From the Earliest to the Present Times

VOLUME 1

WILLIAM WHEWELL



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HISTORY
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HISTORY
OF THE
INDUCTIVE SCIENCES,

FROM THE EARLIEST TO THE PRESENT TIMES.

BY THE
REV. WILLIAM WHEWELL, M.A.,
FELLOW AND TUTOR OF TRINITY COLLEGE, CAMBRIDGE; PRESIDENT OF THE GEOLOGICAL
SOCIETY OF LONDON.

IN THREE VOLUMES.



Λαμπάδια ἔχοντες διαδώσουσιν ἀλλήλοις.

VOLUME THE FIRST.

LONDON :
JOHN W. PARKER, WEST STRAND.
CAMBRIDGE : J. AND J. J. DEIGHTON.

M.DCCC.XXXVII

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TO

SIR JOHN FREDERICK WILLIAM HERSCHEL,
K. G. H.

MY DEAR HERSCHEL,

It is with no common pleasure that I take up my pen to dedicate these volumes to you. They are the result of trains of thought which have often been the subject of our conversation, and of which the origin goes back to the period of our early companionship at the University. And if I had ever wavered in my purpose of combining such reflections and researches into a whole, I should have derived a renewed impulse and increased animation from your delightful Discourse on a kindred subject. For I could not have read it without finding this portion of philosophy invested with a fresh charm; and though I might be well aware that I could not aspire to that large share of popularity which your work so justly gained, I should still have reflected, that something was due to the subject itself, and should have hoped that my own aim was so far similar to yours, that the present work might have a chance of exciting an interest in some of your readers. That it will interest you, I do not at all hesitate to believe.

VOL. I.

a

If you were now in England I should stop here: but when a friend is removed for years to a far distant land, we seem to acquire a right to speak openly of his good qualities. I cannot, therefore, prevail upon myself to lay down my pen without alluding to the affectionate admiration of your moral and social, as well as intellectual excellencies, which springs up in the hearts of your friends, whenever you are thought of. They are much delighted to look upon the halo of deserved fame which plays round your head; but still more, to recollect, as one of them said, that your head is far from being the best part about you.

May your sojourn in the southern hemisphere be as happy and successful as its object is noble and worthy of you; and may your return home be speedy and prosperous, as soon as your purpose is attained!

Ever, my dear Herschel,

Yours,

W. WHEWELL.

5, HYDE PARK STREET,
22 March, 1837.

P R E F A C E.

At the present day, any endeavour to improve and extend the Philosophy of Science may hope to excite some interest. All persons of cultivated minds will agree, that a very important advantage would be gained, if any light could be thrown upon the modes of discovering truth, the powers that we possess for this end, and the points to which these may most profitably be applied. Most men, too, will allow, that in these respects much remains to be done. The attempts of this kind, made from time to time, are far from rendering future efforts superfluous. For example, the Great Reform of Philosophy and Method, in which Bacon so eloquently called upon men to unite their exertions in his day, has, even in ours, been very imperfectly carried into effect. And, even if his plan had been fully executed, it would now require to be pursued and extended. If Bacon had weighed well all that Science had achieved in his time, and had

laid down a complete scheme of rules for scientific research, so far as they could be collected from the lights of that age, it would still be incumbent upon the philosophical world to augment as well as preserve the inheritance which he left; by combining with his doctrines such new views as the advances of later times cannot fail to produce or suggest; and by endeavouring to provide, for every kind of truth, methods of research as effective as those to which we owe the clearest and surest portions of our knowledge. Such a renovation and extension of the reform of philosophy appears to belong peculiarly to our own time. We may discern no few or doubtful presages of its approach; and an attempt to give form and connexion to the elements of such a scheme cannot now be considered premature.

The *Novum Organon* of Bacon was suitably ushered into the world by his *Advancement of Learning*; and any attempt to continue and extend his Reform of the Methods and Philosophy of Science may, like his, be most fitly preceded by, and founded upon, a comprehensive Survey of the existing state of human knowledge. The wish to contribute something, however little it may be, to such a Reform, gave rise to that study of the His-

tory of Science of which the present Work is the fruit. And the effect of these researches has been, a persuasion, that we need not despair of seeing, even in our own time, a renovation of sound philosophy, directed by the light which the History of Science sheds. Such a reform, when its Epoch shall arrive, will not be the work of any single writer, but the result of the intellectual tendencies of the age. He who is most forward in the work will wisely repeat the confession of his sagacious predecessor: *Ipse certè (ut ingenue fatear) soleo æstimare hoc opus magis pro partu Temporis quàm Ingenii.*

To such a work, whensoever and by whomsoever executed, I venture to hope that the present Volumes may be usefully subservient. But I trust, also, that in its independent character, as a History, this book may be found not altogether unworthy of the aim which its title implies.

It is impossible not to see that the writer of such a history imposes upon himself a task of no ordinary difficulty and delicacy; since it is necessary for him to pronounce a judgment upon the characters and achievements of all the great physical philosophers of all ages, and in all sciences. But the assumption

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of this judicial position is so inevitably involved in the functions of the historian (whatever be his subject), that he cannot justly be deemed presumptuous on that account. It is true, that the historian of the progress of science is required by his undertaking to judge of the merits of men, in reference to subjects which demand a far intenser and more methodical study than the historian of practical life gives to the actions of which he treats; and the general voice of mankind,—which may often serve as a guide, because it rarely errs widely or permanently in its estimate of those who are prominent in public life,—is of little value when it speaks of things belonging to the region of exact science. But to balance these disadvantages, and to enable us to judge of the characters who must figure in our history, we may recollect that we have before us, not the record only of their actions, but the actions themselves; for the acts of a philosopher are his writings. We do not receive his exploits on tradition, but by sight; we do not read of him, we read him. And if I may speak of my own grounds of trust and encouragement in venturing on such a task, I knew that my life had been principally spent in those studies which were most requisite to enable

me to understand what had thus been done; and I had been in habits of intercourse with several of the most eminent men of science of our time, both in our own and in other countries. Having thus lived with some of the great intellects of the past and the present, I had found myself capable of rejoicing in their beauties, of admiring their endowments, and, I trusted, also, of understanding their discoveries and views, their hopes and aims. I did not, therefore, turn aside from the responsibility which the character of the Historian of Science imposed upon me. I have not even shrunk from it when it led me into the circle of those who are now alive, and among whom we move. For it seemed to me that to omit such portions of the history as I must have omitted to avoid thus speaking of my contemporaries, would have left my work mutilated and incomplete; and would have prevented its forming a platform on which we might stand and look forward into the future. I trusted, moreover, that my study of the philosophers of former times had enabled me to appreciate the discoveries of the present, and that I should be able to speak of persons now alive, with the same impartiality and in the same spirit as if they were already

numbered with the great men of the past. Seeking encouragement in these reflections, and in the labour and thought which I was conscious of having bestowed upon my task, I have conducted my history from the earliest ages of the speculative world up to our own days.

To some persons it may appear that I am not justified in calling *that* a History of *the* Inductive Sciences, which contains an account of the progress of the *physical* sciences only. But it would have conveyed a false impression of my purpose, had I described my history in any manner which implied that the sciences which it embraces are partially selected or arbitrarily limited. Those of which the progress is exhibited in the present volumes, appear to me to form a connected and systematic body of knowledge. And if there be branches of knowledge which regard Morals, or Politics, or the Fine Arts, and which may properly be called Inductive (an opinion which I by no means gainsay); still it must be allowed, I think, that the processes of collecting general truths from assemblages of special facts, and of ascending from propositions of a limited to those of a larger generality, which the term *Induction* peculiarly implies, have hitherto been far more

clearly exhibited in the physical sciences which form the subject of the present work, than in those hyper-physical sciences to which I have not extended my history. I will further add, that if I should be enabled hereafter to lay before the world a view of the Philosophy of Inductive Science in its general bearings, it will be requisite, in order to exhibit, in its due light the state of the philosophy of morals, or art, or any similar subject, to give a view of the steps by which it has reached its present position; and thus such a work will supply that which some may judge wanting to fill up the outline of this historical undertaking.

As will easily be supposed, I have borrowed largely from other writers, both of the histories of special sciences and of philosophy in general*. I have done this without scruple, since the novelty of my work was intended to consist, not in its supe-

* Among these, I may mention as works to which I have peculiar obligations, Tennemann's *Geschichte der Philosophie*, Degerando's *Histoire Comparée des Systèmes de Philosophie*, Montucla's *Histoire des Mathématiques*, with Delambre's continuation of it, Delambre's *Astronomie Ancienne*, *Astronomie du Moyen Age*, *Astronomie Moderne*, and *Astronomie du Dix-huitième Siècle*; Bailly's *Histoire d'Astronomie Ancienne*, and *Histoire d'Astronomie Moderne*, Voiron's *Histoire d'Astronomie*

rriority as a collection of facts, but in the point of view in which the facts were placed. I have, however, in all cases, given references to my authorities, and there are very few instances in which I have not verified the references of previous historians, and studied the original authors. According to the plan which I have pursued, the history of each science forms a whole in itself, divided into distinct but connected members, by the *Epochs* of its successive advances. If I have satisfied the competent judges in each science by my selection of such epochs, the scheme of the work must be of permanent value, however imperfect may be the execution of any of its portions.

With all these grounds of hope, it is still impossible not to see that such an undertaking is, in no small degree, arduous, and its event obscure. But all who venture upon such tasks must gather trust and encouragement from reflections like those

(published as a continuation of Bailly), Fischer's *Geschichte der Physik*, Gmelin's *Geschichte der Chemie*, Thomson's *History of Chemistry*, Sprengel's *History of Medicine*, his *History of Botany*, and in all branches of *Natural History and Physiology*, Cuvier's works, in their historical, as in all other portions, most admirable and instructive.

PREFACE.

XV

by which their great forerunner prepared himself for his endeavours;—by recollecting that they are aiming to advance the best interests and privileges of man; and that they may expect all the best and wisest of men to join them in their aspirations and to aid them in their labours.

“Concerning ourselves we speak not; but as touching the matter which we have in hand, this we ask;—that men deem it not to be the setting up of an Opinion, but the performing of a Work; and that they receive this as a certainty; that we are not laying the foundations of any sect or doctrine, but of the profit and dignity of mankind:—Furthermore, that being well disposed to what shall advantage themselves, and putting off factions and prejudices, they take common counsel with us, to the end that being by these our aids and appliances freed and defended from wanderings and impediments, they may lend their hands also to the labours which remain to be performed:—And yet, further, that they be of good hope; neither feign and imagine to themselves this our Reform as something of infinite dimension and beyond the grasp of mortal man, when, in truth, it is, of infinite error, the end and true limit; and is by no means unmindful of the

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PREFACE.

condition of mortality and humanity, not confiding
that such a thing can be carried to its perfect close
in the space of one single age, but assigning it as a
task to a succession of generations.”

Instaur. Mag. Præf. ad fin.

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ADDITIONAL NOTE IN VOL. I.

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Page 6, line 7. I have attempted to illustrate somewhat further the nature of Inductive reasoning, in a small work entitled the *Mechanical Euclid*, and in the Remarks annexed thereto.

—

Page 42, line 16, *for* inscribed, *read* invented.