OF THE GRADUAL IMPROVEMENT OF NATURAL PHILOSOPHY.*

1. NATURAL philosophy treats both of God himself, and of his creatures, visible and invisible. Of these I purpose to speak, in such a manner as to ascend from the consideration of man through all the orders of things, as they are farther and farther removed from us, to God the centre of all knowledge. (I mean, of visible things: Of the invisible world we cannot know much, while we dwell in houses of clay.) Thus speculative philosophy ascends from man to God; practical descends from God to man.

2. The most ancient nations, the Egyptians and Hebrews in particular, philosophized much concerning God, and concerning genii, good or evil spirits, of an order superior to man. What they taught concerning the visible world related chiefly to its origin, the changes it was to undergo, and its final dissolution. But on all these heads they only delivered to their posterity what they had received from their forefathers.

3. Among the Greeks, Thales Milesius and his followers applied themselves with great industry to discover, with the best helps they had, the material causes of natural things: They were succeeded by others, who more curiously searched into the structure of natural bodies. Here the foundation of natural history was laid, in various observations on plants, animals, and other things. And herein the endeavours of Aristotle and Theophrastus in particular are to be commended. Yet, in other respects, Aristotle did not promote, but rather obstruct, the knowledge of nature; for he made philosophy as unintelligible by his abstract and metaphysical notions, as Plato, Pythagoras, and others did, by their ideas, numbers, and symbols.

* This article forms the introduction to Mr. Wesley's "Compendium of Natural Philosophy," in five volumes, 12mo. The work was compiled from various authors; but the introduction and conclusion appear to have been his own composition.—EDIT.

4. In succeeding times, when the four Greek sects, the Platonic, Peripatetic, Epicurean, and Stoic, divided the western world between them, the Platonists almost confined themselves and their opinions to the subject of divinity; the Peripatetics regarded little but logic; the Stoics little but moral philosophy; and the Epicureans had small concern about any, being immersed in sensual pleasures: So that none of them made any considerable improvement in any branch of natural philosophy.

5. When the utter barbarism which followed was a little dispelled, Aristotle began to reign. His followers (the Schoolmen, as they were called) might have improved natural philosophy, if (like their master) they had diligently cultivated the knowledge of nature, and searched out the properties of particular things. But it was their misfortune to neglect what was commendable in him, and to follow only what was blameworthy; so as to obscure and pollute all philosophy with abstract, idle, vain speculations. Yet some of them, after the Arabians had introduced the knowledge of chemistry into Europe, were wise above the age they lived in, and penetrated so far into the secret recesses of nature, as scarce to escape the suspicion of magic. Such were Roger Bacon and Albertus Magnus.

6. After the revival of learning, as all other branches of philosophy, so this in particular, received new light. And none was more serviceable herein than Lord Bacon; who, well understanding the defects of the school philosophy, incited all lovers of natural philosophy to a diligent search into natural history. And he himself led them the way, by many experiments and observations.

7. After this, not single persons only, but whole societies applied themselves carefully to make experiments; that, having accurately observed the structure and properties of each body, they might the more safely judge of its nature. And the advantages which have arisen from hence manifestly appear from the Memoirs of the Royal Society at London; of the Academy of Sciences at Paris; and those of the same kind in Germany, as well as several other parts of Europe.

8. To mention but a few of the late discoveries in each branch of natural philosophy: With regard to the structure of a human body, how many things have modern anatomists discovered, which were either little understood by the

ancients, or wholly unknown to them! Such, for instance, is the circulation of the blood, discovered by Dr. William Harvey, whose "Anatomic Exercitations" concerning it were first published in the year 1628. Such were the lacteal veins, discovered first in brutes by Casper Asellius, of Cremona; and soon after in men. Such the thoracic duct, and receptacle of the chyle, observed first by Dr. John Pecquet, of Paris, whereby the whole course of the blood is now clearly understood.

9. Dr. Harvey improved natural philosophy by another no less eminent discovery; for he was the first of the moderns that showed all animals to be generated from eggs. That the ancients knew and taught this, (Orpheus in particular,) cannot reasonably be doubted. But as the knowledge of it was entirely lost, to revive was the same thing as to invent it. It is obvious, how great a light this pours upon that dark subject, with regard to the generation of men, as well as of other animals.

10. Another remarkable discovery in the last century was that of the transfusion of the blood. The blood of a young, lively, healthy animal was transfused, by means of a small silver tube, properly adjusted, into the veins of another, which was old, weak, and sickly. And the effect amazed all the beholders. When the experiment was tried before several of the Royal Society, a feeble, worn-out dog, ready to die with age, and hardly able to trail his legs after him, was no sooner filled with young blood, than he leaped up as from sleep, shook himself, and ran up and down, as lively and active as a puppy. In France the experiment has been made upon men, and with as surprising success. What pity that so important an experiment should ever fall into disuse! that it is not still repeated upon proper occasions! especially where all other means fail.

11. It cannot be denied, that Physicians have signally improved this branch of philosophy, as they have continual opportunities of making new discoveries in the human body. In diseases themselves, the wonderful wisdom of the Author of nature appears; and by means of them many hidden recesses of the human frame are unexpectedly discovered. The powers of medicines also, variously exerting themselves, lay open many secrets of nature.

12. And how many things in all bodies, as well as in the

human, which eluded all the art and industry of the ancients, have the moderns discovered by the help of microscopes! although these are not properly a modern invention; it being certain something of this kind was in use many hundred years ago. There are several works of great antiquity still extant; the beauties of which cannot even be discerned, much less could they have been wrought, by the finest naked eye which ever was in the world. Such is that seal, now in the cabinet of the King of France, allowed to be at least fifteen hundred years old, six-tenths of an inch long, and four broad, which to the naked eye presents only a confused group; but, surveyed with a microscope, distinctly exhibits trees, a river, a boat, and sixteen or seventeen persons.

13. Now, whatever assists us in searching out the structure of a human body, equally helps us to find out the nature and properties of other animals. Hence in these likewise we have received great light from anatomical and microscopical observations. Those especially who have bestowed their whole time and thoughts on one kind of animals, (as Dr. Willoughby, on fishes, Dr. Swammerdam, of Amsterdam, on insects,) have illustrated, to a surprising degree, the subjects on which they wrote.

14. Many have diligently searched into the nature of plants; particularly Mr. Ray, who has not only ranged them in a new method, but also wrote an elaborate history of them. Others have described, with equal diligence, either plants in general, or those of a particular country. And others have shown the like industry in finding out and explaining the nature of stones, metals, minerals, and other fossils.

15. Nor is it strange that the moderns have penetrated farther into the recesses of nature than the ancients, considering the advantages they have received from the art of chemistry. Not that this is an invention of later ages: It was in some measure known long ago. But as this art has been cultivated in our age, with far greater accuracy than ever; so by this means many properties of natural bodies have been discovered; of fossils in particular.

16. But none of these have so much engaged the study of the learned, or so well deserved it, as the loadstone. Its attractive force was known to the ancients, and the origin

of that discovery is recorded by Pliny. But it does not appear that they knew of its pointing to the pole, or of the use of the compass. This (the compass) was invented by John Goia, in the year 1300. But it has since been observed, that the magnetic needle seldom points exactly to the pole; but varies from it some degrees to the east or west, in a fixed and regular order.

17. Nearly related to the nature of fossils is glass, which was well known to the ancients, being mentioned by Plutarch and Lucian among the Greeks, by Lucretius, Pliny, and others, among the Latins. Yet the art of making glass has been since their times abundantly improved. One branch of this is, the art of making burning-glasses, which are now brought to so great perfection, as either to melt or reduce to ashes the most solid bodies, in a few moments. If these were known to the ancients at all, (which may reasonably be doubted,) yet the art was wholly lost for many ages, and not recovered till of late years.

18. Later ages have likewise made many discoveries with regard to earth, water, fire, and air; the last of which, air, though it be of so fine a texture as to be wholly invisible, yet, producing such amazing effects, has excited the most diligent inquiries of the curious. Nor does any part of philosophy afford a wider field for experiments and discoveries. The weight of it we can ascertain by that curious instrument the barometer, invented by Torricellius; the degrees of heat and cold, by the thermometer. By the air-pump, (invented by Otto Guerick, Mayor of Magdeburgh,) the air is drawn out of any bodies, or more largely thrown into them; and hereby many effects are produced, which deserve our diligent consideration.

19. With regard to water, the discoveries of later times are numerous and important. Such are the diving-bell, invented by George Sinclair; the diving-machine of Alphonso Borelli, a kind of boat, which is so contrived as to be navigated under water; and the art of making salt-water fresh, which is now done with little expense, so far that the saltness is taken away, and it is fit for almost all uses.

20. The nature and properties of fire also have been accurately traced in late ages; for which new occasion was given by the invention of gunpowder, by Berthold Schwartz, in the fourteenth century. *Aurum fulminans*, a yet later

invention, goes off with a louder explosion than gunpowder. Other bodies there are which do not burn, yet emit light. Such is the Bononian stone, which, placed in the dark, diffuses light like a burning coal. It is well known that the preparation called phosphorus has the same property.

21. Various theories of the earth have lately appeared. But they are no more than ingenious conjectures. The same may be said of the systems of the universe, a few particulars excepted. The Ptolemaic system, which supposes the earth to be the centre of the universe, is now deservedly exploded; since Copernicus has revived that of Pythagoras, which was probably received by most of the ancients. Tycho Brahe's, which jumbles both together, is too complex and intricate, and contrary to that beautiful simplicity, conspicuous in all the works of nature.

22. The telescope (invented by Galileo) has discovered many stars unknown to the ancients, together with the nature and motion of the planets, both primary and secondary. By this also have been discovered the spots of the sun, the inequality of the surface of the moon, the nature of the galaxy, or milky way, and many other particulars relating to the heavens.

23. With regard to body in general, it is commonly supposed that our age has a vast advantage over antiquity, by having found out new principles and new hypotheses, whereby we can account for all the secrets of nature. But this will bear a dispute. For beside that the chief of our hypotheses are not new, but known long ago, the learned have hitherto very little profited by all their hypotheses. And, in truth, all their disquisitions touching the causes of natural bodies terminate in mere conjectures; one whereof is often more probable than another; but none admits of any solid proof.

24. What remains of natural philosophy is, the doctrine concerning God and spirits. But in the tracing of this we can neither depend upon reason nor experiment. Whatsoever men know or can know concerning them, must be drawn from the oracles of God. Here, therefore, we are to look for no new improvements; but to stand in the good old paths; to content ourselves with what God has been pleased to reveal; with "the faith once delivered to the saints."

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