are impressed inevitably on the minds of thinking men. Thus it is to astronomy we must look for the first development of scientific ideas. The orientation of many prehistoric monuments shows that a certain amount of astro­nomical observation had been acquired at a very early age, and the Chaldeans seem to have gone so far as to recognize a law of periodicity even in eclipses. From the land of Asia the Greeks took their earliest ideas of science, and it is to the Ionian philosophers, of whom Thales of Miletus (580 **B.C.)** is regarded as the first, that we must turn for the earliest known example of an advance on the mythological view of nature.

Anaximenes recognized the rotation of the heavens round the pole star, and saw that the dome overhead was but the half of a complete sphere. The earth was thus deprived of the base stretching to unfathomed depths imagined by the mythologists, and left free to float as a flattened cylinder at the centre of the celestial sphere. Anaximenes, too, seems to have grasped the doctrine of the uniformity of nature, teaching that all material transformations must have a true cause.

Next came the Pythagoreans, who simplified these conceptions by the suggestion that instead of a rotation of the vast sphere of the heavens the earth itself might be a sphere and revolve about a central fixed point, like a stone at the end of a string. The unin­habited side of the earth always faced the fixed point, and its in­habited side faced successively the different parts of the heavens. At the central fixed point they placed a “ universal fire,” which, like the fire on an altar, served as a centre for the circling of the worshipping earth. Mythology was losing its hold of science, but mystical symbolism still held sway. When, however, in the 4th century B.c. the growth of geographical discovery failed to disclose any trace of this central fire, the idea of its existence faded away, and was replaced by the conception of the revolution of the earth on its own axis. Finally, Aristarchus (280 b.c.), believing that the sun was larger than the earth, thought it unlikely that it should revolve round the earth, and developed a heliocentric theory. But the time was not ripe; no indisput­able evidence could be adduced, no general conviction followed, and to mankind the earth remained the centre of creation till many centuries later. Even to Lucretius, the visible universe consisted of the central earth with its attendant water, air and aether founded by the sphere of the heavens, which formed the flaming walls of the world—*flammantia moenia mundi.*

Simultaneously with the birth of astronomy the problem of matter came into being. The old Ionian nature philosophers, observing the sequence of changes from earth and water into the structure of plants and the bodies of animals, and through them again into the original constituents, began to grasp the conception of the indestructibility of matter, and to put forward the idea that all forms of matter might ultimately consist of a single “ element.” But the conception of a single ultimate basis of matter was far in advance of the age. It is only now becoming a fertile working hypothesis in the light of all the gigantic increase in knowledge of the intervening two thousand years. At the time when it was put forward, the conception was of little use, and the immedi­ate path of advance was found in the idea of Empedocles (450 B.C.)that the primary elements were four: earth, water, air and fire— a solid, a liquid, a gas and the flame which seemed to the ancients a type of matter of still rarer structure. This hypothesis served to interpret the phenomena of nature for many centuries, till, in modern days, the growth of chemistry disclosed the seventy or eighty elements of our text-books. Signs are not wanting that they too have served their turn as a conception of the ultimate nature of matter, while still maintaining their place as the

proximate units of chemical action.

In the four elements of Empedocles we trace the germ of the ideas of the Atomists. Empedocles saw that, by combining his separate elements in different proportions, he could explain all the endless differences in matter as known to the senses. Leucippus and Democritus developed the conception and gave to the world the theory of atoms, described at a later date by the Roman poet Lucretius. As

matter is subdivided does it keep its characteristic properties throughout? Is iron always iron, however finely we divide it; is water alwaýs water? Are the properties of any kind of matter ultimate facts of which no explanation—no description in simpler terms—is possible? To avoid answering this last question in the affirmative, and resigning all hope of an advance in knowledge, the atomic theory of the Greeks was framed.

To recognize the significance of the doctrines of the Greek Atomists, we must remove from our minds all sense of comparison with the atomic theory of to-day. The Greeks had none of the detailed physical and chemical knowledge on which that theory is founded, and which it was framed to explain. The object of Leucippus and Democritus was quite different from that of Dalton and Avogadro. To the latter, the conception of atoms and molecules served as a means of explaining certain definite and detailed facts of chemical combination and gaseous volume in a more definite and exact way than any other hypothesis available at the time. To the Greek philosophers, the atomic theory was an attempt to make the universe intelligible. The particular explanation offered was not of so much importance as the idea that an explanation of some kind was possible. When we see the beliefs that held sway before their day, we realize the advance their ideas produced. The qualities of substances were thought to be of their essence—the sweetness of sugar was as much a reality as sugar itself, the black colour of water must survive all changes in its form, so that, to one who knew this doctrine, snow could never look white again. It was such con­fusion as this—such denial of facts if they failed to support a theory—that Democritus assailed:— “ According to convention there is a sweet and a bitter, a hot and a cold, and according to convention there is colour. In truth there are atoms and a void.” Atoms were many in size and shape, but identical in substance. All qualitative differences in substances were to be assigned to differences in size, shape, situation and movement of particles of the same ultimate nature. No attempt was made to examine into the nature of this ultimate substance; but one set of phenomena was expressed in terms of something simpler, and no “ explanation ” even of the most recondite observation by the most modern physicist can do more.

The atomic theory of the Greeks as transmitted to us by the poem of Lucretius presented a wonderfully consistent picture of nature within the limits of the knowledge of their day. It is easy to show where it fails in the light of the knowledge of phenomena we now possess; it is easy to point to places where, as in its application to psychological problems, its authors passed in imagination over logical chasms without even seeing that a difficulty existed. But the attempt to frame an íhtelligible picture was a great step in advance, and a study of the flaws which we can now detect may serve to suggest the provisional nature of some of the theories by the aid of which knowledge is advancing so fast in our own day.

But the great difference between the position of the Greeks and that of ourselves in regard to natural knowledge consists in the small number of phenomena known to them contrasted with the enormous wealth of accumulated observation which is available for us, as the result of years of experiment with the aid of apparatus unknown to the ancients. When a new theory is put forward, it is now almost always possible to test its concordance with facts by the use of material already accumulated, or to suggest, in the h\*ght of such material, experiments which will serve to refute it, or to lend it greater probability. Thus a theory which survives the trials that follow its birth has nowadays a fairly long expectation of life—probably the theory will serve to interpret phenomena discovered either by its means or in other ways for some time to come. But in the ancient world this was not so. To test a new theory, other phenomena were very rarely available than those which sug­gested it, or to explain which it was put forward. Thus thought was much more speculative, and, as is still the case with meta­physics, no general consensus of opinion was reached. Each philosopher had a system of his own in science, just as he still has in metaphysics—a system which, beginning from first