SCIENCE AND THE UNSEEN WORLD

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Synopsis

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LOOKING BACK THROUGH THE long past we picture the beginning of the world – a primeval chaos which time has fashioned into the universe that we know. Its vastness appals the mind; space boundless though not infinite, according to the strange doctrine of science. The world was without form and almost void. But at the earliest stage we can contemplate the void is sparsely broken by tiny electric particles, the germs of the things that are to be; positive and negative they wander aimlessly in solitude, rarely coming near enough to seek or shun one another. They range everywhere so that all space is filled, and yet so empty that in comparison the most highly exhausted vacuum on earth is a jostling throng. In the beginning was vastness, solitude and the deepest night. Darkness was upon the face of the deep, for as yet there was no light.

The years rolled by, million after million. Slight aggregations occurring casually in one place and another drew to themselves more and more particles. They warred for sovereignty, won and lost their spoil, until the matter was collected round centres of condensation leaving vast empty spaces from which it had ebbed away. Thus gravitation slowly parted the primeval chaos. These first divisions were not the stars but what we should call "island universes", each ultimately to be a system of some thousands of millions of stars. From our own island universe we can discern the other islands as spiral nebulae lying one beyond another as far as the telescope can fathom. The nearest of them is such that light takes 900,000 years to cross the gulf between us. They acquired rotation (we do not yet, how) which bulged them into flattened form and made them wreathe themselves in spirals. Their forms, diverse yet with underlying regularity, make a fascinating spectacle for telescopic study.

As it had divided the original chaos, so gravitation subdivided the island universes. First the star clusters, then the stars themselves were separated. And with the stars came light, born of the fiercer turmoil which ensued when the electrical particles were drawn from their solitude into dense throngs. A star is not just a lump of matter casually thrown together in the general confusion; it is of nicely graded size. There is relatively not much more diversity in the masses of new-born stars than in the masses of new-born babies. Aggregations rather greater than our Sun have a strong tendency to sub-divide, but when the mass is reduced a little the danger quickly passes and the impulse to sub-division is satisfied. Here it would seem the work of creation might cease. Having carved chaos into stars, the first evolutionary impulse has reached its goal. For many billions of years the stars may continue to shed their light and heat through the world, feeding on their own matter which disappears bit by bit into ætherial waves.

Not infrequently a star, spinning too fast or strained by the radiant heat imprisoned within it, may divide into two nearly equal stars, which remain yoked together as a double star; apart from this no regular plan of further development is known. For what might be called the second day of creation we turn from the general rule to the exceptions. Amid so many myriads there will be a few which by some rare accident have a fate unlike the rest. In the vast expanse of the heavens the traffic is so thin that a star may reasonably count on travelling for the whole of its long life without serious risk of collision. The risk is negligible for any individual star; but ten thousand million stars in our own system and more in the systems beyond afford a wide playground for chance. If the risk is one in a hundred millions some unlucky victims are doomed to play the role of "one". This rare accident must have happened to our Sun – an accident to the Sun, but to us the cause of our being here. A star journeying through space casually overtook the Sun, not indeed colliding with it, but approaching so close as to raise a great tidal wave. By this disturbance jets of matter spurted out of the Sun; being carried round by their angular momentum they did

not fall back again but condensed into small globes – the planets. By this and similar events there appeared here and there in the universe something outside Nature's regular plan, namely a lump of matter small enough and dense enough to be cool. A temperature of ten million degrees or more prevails through the greater part of the interior of a star; it cannot be otherwise so long as matter remains heaped in immense masses. Thus the design of the first stage of evolution seems to have been that matter should ordinarily be endowed with intense heat. Cool matter appears as an afterthought. It is unlikely that the Sun is the only one of the starry host to possess a system of planets, but it is believed that such development is very rare. In these exceptional formations Nature has tried the experiment of finding what strange effects may ensue if matter is released from its usual temperature of millions of degrees and permitted to be cool.

Out of the electric charges dispersed in the primitive chaos ninety-two different kinds of matter – ninety-two chemical elements – have been built. This building is also a work of evolution, but little or nothing is known as to its history. In the matter which we handle daily we find the original bricks fitted together and cannot but infer that somewhere and somewhen a process of matter-building has occurred. At high temperature this diversity of matter remains as it were latent; little of consequence results from it. But in the cool experimental stations of the universe the differences assert themselves. At root the diversity of the ninety-two elements reflects the diversity of the integers from one to ninety-two; because the chemical characteristics of element No. 11 (sodium) arise from the fact that it has the power at low temperatures of gathering round it eleven negative electric particles; those of No. 12 (magnesium) from its power of gathering twelve particles; and so on.

It is tempting to linger over the development out of this fundamental beginning of the wonders studied in chemistry and physics, but we must hurry on. The provision of certain cool planetary globes was the second impulse of evolution, and it has exhausted

itself in the formation of inorganic rocks and ores and other materials. We must look to a new exception or abnormality if anything further is to be achieved. We can scarcely call it an accident that among the integers there should happen to be the number 6; but I do not know how otherwise to express the fact that organic life would not have begun if Nature's arithmetic had overlooked the number 6. The general plan of ninety-two elements, each embodying in its structural pattern one of the first ninety-two numbers, contemplates a material world of considerable but limited diversity; but the element carbon, embodying the number 6, and because of the peculiarity of the number 6, rebels against limits. The carbon atoms love to string themselves in long chains such as those which give toughness to a soap-film. Whilst other atoms organise themselves in twos and threes or it may be in tens, carbon atoms organise themselves in hundreds and thousands. From this potentiality of carbon to form more and more elaborate structure a third impulse of evolution arises.

I cannot profess to say whether anything more than this prolific structure-building power of carbon is involved in the beginning of life. The story of evolution here passes into the domain of the biological sciences for which I cannot speak, and I am not ready to take sides in the controversy between the Mechanists and the Vitalists. So far as the earth is concerned the history of development of living forms extending over nearly a thousand million years is recorded (though with many breaks) in fossil remains. Looking back over the geological record it would seem that Nature made nearly every possible mistake before she reached her greatest achievement Man – or perhaps some would say her worst mistake of all. At one time she put her trust in armaments and gigantic size. Frozen in the rock is the evidence of her failures to provide a form fitted to endure and dominate – failures which we are only too ready to imitate. At last she tried a being of no great size, almost defenceless, defective in at least one of the more important sense – organs; one gift she bestowed to save him from threatened

extinction – a certain stirring, a restlessness, in the organ called the brain.

And so we come to Man.

II

It is with some such thoughts as these of the relation of Man to the visible universe that the scientifically minded among us approach the problem of his relation to the Unseen World. It is not with any dogmatic challenge that I have given this outline of evolution. Part of what I have described seems to be securely established; other parts involve a considerable element of conjecture – the best we can do to string together fragmentary knowledge. Scientific theories have blundered in the past; they blunder no doubt to-day; yet we cannot doubt that along with the error there come gleams of a truth for which the human mind is impelled to strive. So brief a summary cannot convey the true spirit and intention of this scientific probing of the past, any more than the spirit of history is conveyed by a table of dates. We seek the truth; but if some voice told us that a few years more would see the end of our journey, that the clouds of uncertainty would be dispersed, and that we should perceive the whole truth about the physical universe, the tidings would be by no means joyful. In science as in religion the truth shines ahead as a beacon showing us the path; we do not ask to attain it; it is better far that we be permitted to seek.

I daresay that most of you are by no means reluctant to accept the scientific epic of the Creation, holding it perhaps as more to the glory of God than the traditional story. Perhaps you would prefer to tone down certain harshnesses of expression, to emphasise the forethought of the Creator in the events which I have called accidents. I would not venture to say that those who are eager to sanctify, as it were, the revelations of science by accepting them as new insight into the divine power are wrong. But this attitude is liable to grate a little on the scientific mind, forcing its free spirit

of inquiry into one predetermined mode of expression; and I do not think that the harmonising of the scientific and the religious outlook on experience is assisted that way. Perhaps our feeling on this point can be explained by a comparison. A business man may believe that the hand of Providence is behind his commercial undertakings as it is behind all the vicissitudes of his life; but he would be aghast at the suggestion that Providence should be entered as an asset in his balance sheet. I think it is not irreligion but a tidiness of mind, which rebels against the idea of permeating scientific research with a religious implication.

Probably most astronomers, if they were to speak frankly, would confess to some chafing when they are reminded of the psalm "The heavens declare the glory of God." It is so often rubbed into us with implications far beyond the simple poetic thought awakened by the splendour of the star-clad sky. There is another passage from the Old Testament that comes nearer to my own sympathies:

> "And behold the Lord passed by, and a great and strong wind rent the mountains, and brake in pieces the rocks before the Lord; but the Lord was not in the wind: and after the wind an earthquake; but the Lord was not in the earthquake: and after the earthquake a fire; but the Lord was not in the fire: and after the fire a still small voice.… And behold there came a voice unto him, and said, What doest thou here, Elijah?"

Wind, earthquake, fire – meteorology, seismology, physics – pass in review, as we have been reviewing the natural forces of evolution; the Lord was not in them. Afterwards, a stirring, an awakening in the organ of the brain, a voice which asks "What doest thou here?"

III

We have busied ourselves with the processes by which the electric particles widely diffused in primeval chaos have come together to

build the complexity of a human being; we cannot but acknowledge that a human being involves also something incommensurable with the kind of entities we have been treating of. I do not mean to say that consciousness has not undergone evolution; presumably its rudiments exist far down the scale of animal life. But it is a constituent or an aspect of reality which our survey of the material world leaves on one side. Hence arises insistently the problem of the dualism of spirit and matter. On the one side there is consciousness stirring with activity of thought and sensation; on the other side there is a material brain, a maelstrom of scurrying atoms and electric charges. Incommensurable as they are, there is some kind of overlap or contact between them. As the mind is traversed by a certain thought the atoms at some point of the brain range themselves so as to start a material impulse transmitting the mental command to a muscle; or again a nervous impulse arrives from the outer world, and as the atoms of a brain-cell move in response to the physical forces simultaneously a sensation of pain occurs in the mind.

Let us for a moment consider the most crudely materialistic view of this connection. It would be that the dance of atoms in the brain really constitutes the thought, that in our search for reality we should replace the thinking mind by a system of physical objects and forces, and that by so doing we strip away an illusory part of our experience and reveal the essential truth which it so strangely disguises. I do not know whether this view is still held to any extent in scientific circles, but I think it may be said that it is entirely out of keeping with recent changes of thought as to the fundamental principles of physics. Its attractiveness belonged to a time when it was considered that the way to understand or explain a scientific phenomenon was to make a concrete mechanical model of it.

I cannot in a few moments make clear a change of thought which it has taken a generation to accomplish. I can only say that physical science has turned its back on all such models, regarding them now rather as a hindrance to the apprehension of the truth behind the phenomena. We have the same desire as of old to get to the bottom

of things, but the ideal of what constitutes a scientific explanation has changed almost beyond recognition. And if to-day you ask a physicist what he has finally made out the æther or the electron to be, the answer will not be a description in terms of billiard balls or fly-wheels or anything concrete; he will point instead to a number of symbols and a set of mathematical equations which they satisfy. What do the symbols stand for? The mysterious reply is given that physics is indifferent to that; it has no means of probing beneath the symbolism. To understand the phenomena of the physical world it is necessary to know the equations which the symbols obey but not the nature of that which is being symbolised. It would be irrelevant here to defend this change, to make clear the intellectual satisfaction afforded by these symbolic equations, or to explain why the demand of the layman for a concrete explanation has to be set aside. We have, however, to see how this newer outlook has modified the challenge from the material to the spiritual world.

For those who were bent on finding a model for everything, the material brain appeared in the light of a ready-made model of the mind. And being a model, it was for them the full explanation of the mind. A mechanism of concrete particles, like the billiard-ball atoms of the brain, was their ideal of an explanation. They were hoping similarly to find a mechanism of gyrostats and cog-wheels to explain the æther. The cog-wheels of the æther were hidden, but the cog-wheels of the mind seemed to be at any rate partly exposed. The mere sight of such machinery gave them a feeling of satisfaction, even if they could not tell in the least how it worked. I am not here greatly concerned with the question whether, or to what extent, the brain-cells may rightly be regarded as the cog-wheels of the mind. What I wish to point out is that we no longer have the disposition which, as soon as it scents a piece of mechanism, exclaims "Here we are getting to bedrock. This is what things should resolve themselves into. This is ultimate reality." Physics to-day is not likely to be attracted by a type of explanation of the mind which it would scornfully reject for its own æther.

Perhaps the most essential change is that we are no longer