

THE EXPERIENCE OF CREATION

I.

All the way back to the cave paintings and the invention of the first stone tools, what moved men to create was an everyday impulse. But it was an impulse in the everyday of men, not of animals. Whether we search for the beginnings of creativity either in art or in science, we have to go to those faculties which are human and not animal faculties. Something happens on the tree of evolution between the big apes and ourselves which is bound up with the development of personality; and once our branch has sprung out, a painter like Santi Raphael and a chemist like Humphry Davy both lie furled in the human beginning like the leaves in the bud. What the painter and the inventor were doing, right back in the cave, was unfolding the gift of intelligent action.

If I am to ask you to study this gift, I must point to some distinction between animal behavior and human behavior. One characteristic of animal behavior is that it is dominated by the physical presence of what the animal wants or fears. The mouse is dominated by the cat, the rabbit by the stoat; and equally, the hungry animal is dominated by the sight and smell of food, or of a mate, which make him blind to everything else present. A mastiff with food just outside his cage cannot tear himself away from the bars; the food fixes him, physically, by its closeness. Move the food a few feet away from the cage, and he feels

released; he remembers that there is a door at the back of the cage, and now that he can take his eyes off the food, away he races through the door and around to the front.

This and many other experiments make plain the compulsions which hold an animal. Even outside the clockwork of his instinctive actions, his needs fix and drive him so that he has no room for manoeuvre. A main handicap in this, of course, is that the animal lacks any apparatus, such as human speech, by which he can bring to mind what is not present. Without speech, without a familiar symbolism, how can the mastiff's mind attend to the door behind him? His attention is free, his intelligence can manoeuvre, only within the few feet in which the food is not too close to the cage and is yet within range of sight or smell.

Man has freed himself from this dominance in two steps. First, he can remember what is out of sight. The apparatus of speech allows him to recall what is absent, and to put it beside what is present; his field of action is larger because his mind holds more choices side by side. And second, the practice of speech allows man to become familiar with the absent situation, to handle and to explore it, and so at last to become agile in it and control it. To my mind, the cave painting as much as the chipped flint tool is an attempt to control the absent environment, and both are created in the same temper; they are exercises in freeing man from the mechanical drives of nature.

Evolution has had, for man, the direction of liberty. Of course, men do at times act from necessity, as animals do. But we know them to be men when their actions have an untroubled liberty; when children play, when the young find a pleasure in abstract thought, when in maturity we weigh and choose between two ambitions. These are the human acts, and they are beautiful as a painting or an invention is beautiful, because the mind in them is free and exuberant.

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Now I turn our attention to action in the field of science. The most remarkable discovery made by scientists is science itself. The discovery must be compared in importance with the invention of cave-painting and of writing. Like these earlier human creations, science is an attempt to control our surroundings by

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entering into them and understanding them from inside. And like them, science has surely made a critical step in human development which cannot be reversed. We cannot conceive a future society without science.

I have used three words to describe these far-reaching changes: discovery, invention, and creation. There are contexts in which one of these words is more appropriate than the others. Christopher Columbus discovered the West Indies, and Alexander Graham Bell invented the telephone. We do not call their achievements creations because they are not personal enough. The West Indies were there all the time; and as for the telephone, we feel that Bell's ingenious thought was somehow not fundamental. The groundwork was there, and if not Bell then someone else would have stumbled on the telephone almost as accidentally as on the West Indies.

By contrast, we feel that *Othello* is genuinely a creation. This is not because *Othello* came out of a clear sky; it did not. There were Elizabethan dramatists before William Shakespeare, and without them he could not have written as he did. Yet within their tradition *Othello* remains profoundly personal; and though every element in the play has been a theme of other poets, we know that the amalgam of these elements is Shakespeare's; we feel the presence of his single mind. The Elizabethan drama would have gone on without Shakespeare, but no one else would have written *Othello*.

There are discoveries in science like Columbus's, of something which was always there: the discovery of sex in plants, for example. There are also tidy inventions like Bell's, which combine a set of known principles: the use of a beam of electrons as a microscope, for example. Now we have to ask the question: Is there anything more? Does a scientific theory, however deep, ever reach the roundness, the expression of a whole personality that we get from *Othello*?

A fact is discovered, a theory is invented; is any theory ever deep enough for it to be truly called a creation? Most non-scientists would answer: No! Science, they would say, engages only part of the mind—the rational intellect—but creation must engage the whole mind. Science demands none of that groundswell of emotion, none of that rich bottom of personality, which fills out the work of art.

This picture by the nonscientist of how a scientist works is of course mistaken. A gifted man cannot handle bacteria or equations without taking fire from what he does and having his emotions engaged. It may happen that his emotions are immature, but then so equally are the intellects of many poets. When Ella Wheeler Wilcox died, having published poems from the age of seven, *The Times* of London wrote that she was "the most popular poet of either sex and of any age, read by thousands who never open Shakespeare." A scientist who is emotionally immature is like a poet who is intellectually backward: both produce work which appeals to others like them, but which is second-rate.

I am not discussing the second-rate, and neither am I discussing all that useful but commonplace work which fills most of our lives, whether we are chemists or architects. There were in my laboratory of the British National Coal Board about 200 industrial scientists—pleasant, intelligent, sprightly people who thoroughly earned their pay. It is ridiculous to ask whether they were creators who produced works that could be compared with *Othello*. They were men with the same ambitions as other university graduates, and their work was most like the work of a college department of Greek or of literature. When the Greek departments produce a Sophocles, or the literature departments produce a Shakespeare, then I shall begin to look in my laboratory for an Isaac Newton.

Literature ranges from William Shakespeare to Ella Wheeler Wilcox, and science ranges from relativity to market research. A comparison must be of the best with the best. We must look for what is created in the deep scientific theories: in Nicolaus Copernicus and Charles Darwin, in Thomas Young's theory of light and in William Rowan Hamilton's mathematics, in the pioneering concepts of Sigmund Freud, of Niels Bohr and of Ivan Petrovich Pavlov.

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Creation consists in finding unity, finding likenesses, finding pattern. The poet Samuel Taylor Coleridge in his many stumbling attempts, all of them brilliant and all of them inconclusive, to find a definition of beauty, always came back to the same thought: that beauty is "unity in variety." In my view, this is the ex-

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perience of creation. Nature herself is chaos; she is full of infinite variety without order. But if you see her with inner vision, a creative mind (whether a poetic mind like Charles Baudelaire's or a scientific mind like Isaac Newton's), there comes a moment when many different aspects suddenly crystallize in a single unity. You have found a key; you have found a clue; you have found the path which organizes the material. You have found what Coleridge called "unity in variety." That is the moment of creation.

The scientist's demand that nature shall be lawful is a demand for unity. When he frames a new law, he links and organizes phenomena which were thought different in kind; for example, general relativity links light with gravitation. In such a law we feel that the disorder of nature has been made to reveal a pattern, and that under the colored chaos there rules a more profound unity.

A man becomes creative, whether he is an artist or a scientist, when he finds a new unity in the variety of nature. He does so by finding a likeness between things which were not thought alike before, and this gives him a sense at the same time of richness and of understanding. The creative mind is a mind that looks for unexpected likenesses. This is not a mechanical procedure, and I believe that it engages the whole personality in science as in the arts. Certainly I cannot separate the abounding mind of Thomas Young (which almost deciphered the Rosetta Stone) from his recovery of the wave theory of light, or the awkwardness of J. J. Thomson in experiment from his discovery of the electron. To me, William Rowan Hamilton drinking himself to death is as much part of his prodigal mathematical invention as is any drunken young poet; and the child-like vision of Albert Einstein has a poet's innocence.

When Max Planck proposed that the radiation of heat is discontinuous, he seems to us now to have been driven by nothing but the facts of experiment. But we are deceived; the facts did not go so far as this. The facts showed that the radiation is not continuous; they did not show that the only alternative is Max Planck's hail of quanta. This is an analogy which imagination and history brought into Max Planck's mind. So the later conflict in quantum physics between the behavior of matter as a wave and as a particle is a conflict between analogies, between poetic met-

aphors; and each metaphor enriches our understanding of the world without completing it.

In *Auguries of Innocence* the poet William Blake wrote:

A dog starv'd at his Master's gate
Predicts the ruin of the State.

This seems to me to have the same imaginative incisiveness, the same understanding crowded into metaphor, that Max Planck had. And the imagery is as factual, as exact in observation, as that on which Planck built; the poetry would be meaningless if William Blake used the words *dog*, *master* and *State* less robustly than he does. Why does Blake say *dog* and not *cat*? Why does he say *master* and not *mistress*? Because the picture he is creating depends on our factual grasp of the relation between dog and master. William Blake is saying that when the master's conscience no longer urges him to respect his dog, the whole society is in decay (is, in fact, going to the dogs). This profound thought came to Blake again and again: that a morality expresses itself in what he called its Minute Particulars—that the moral detail is significant of a society. As for the emotional power of the couplet, it comes, I think, from the change of scale between the metaphor and its application: between the dog at the gate and the ruined State. This is why William Blake, in writing it, seems to me to transmit the same excitement that Max Planck felt when he discovered, no, when he created, the quantum.

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The discoveries of science, the works of art are explorations—more, are explosions, of a hidden likeness. The discoverer or the artist presents in them two aspects of nature and fuses them into one. This is the experience of creation, in which an original thought is born, and it is the same experience in original science and original art. But it is not therefore the monopoly of the man who wrote the poem or who made the discovery. On the contrary, I believe this view of the creative experience to be right because it alone gives a meaning to the experience of appreciation. The poem or the discovery exists in two moments of vision: the moment of appreciation as much as that of creation; for the

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appreciator must see the movement, wake to the echo which was started in the creation of the work. In the experience of appreciation we live again the moment when the creator saw and held the hidden likeness. When a simile takes us aback and persuades us together, when we find a juxtaposition in a picture both odd and intriguing, when a theory is at once fresh and convincing, we do not merely nod over someone else's work. We re-enact the creative act, and we ourselves make the discovery again. At bottom, there is no unifying likeness there until we the spectators have seized it too, we too have made it for ourselves.

The experience of creation is, I have said, the same in science as in art. It is a natural, human, living experience. Yet, of course, a poem is obviously not like a theorem. How does it differ? That has nothing to do with how it is composed; the units differ because they match human experience in different ways. Take a theorem like that of Pythagoras; this is a theorem every child re-discovers. He always re-discovers it in the same form; his experience is intellectual and can be exactly matched. In the arts this does not happen. Many people are going to paint pictures with a human being and an animal, but nobody is going to paint *The Lady with the Stroat* again exactly as Leonardo da Vinci did. Many people are going to write plays, not exactly like *Othello*, but on a similar theme. In the arts, it is not possible for the experience of one individual to match that of another, as if it were a blueprint. You do not read a work of art for this purpose; you re-create it, but you do not re-create the blueprint. You explore your own experience; you learn; you live; you expand inside. The difference between the arts and the sciences lies not in the process of creation, but in the nature of the match between the created work and your own re-creation in appreciating it.