

THE TRUTH OF IMAGINATION

There is an obscure passage in a letter from Keats to Benjamin Bailey, written in 1817, which says:

I am certain of nothing but of the holiness of the Heart's affections
and the truth of Imagination . . .

This does not seem to make much sense. Nor does it help much to find an echo of that passage in the famous last lines of the *Ode on a Grecian Urn*, written two years later:

Beauty is truth, truth beauty — that is all
Ye know on earth, and all ye need to know.

No doubt there is beauty in these lines, but do they speak the truth? I happen to believe that they do, but the relationship between truth and beauty, or more generally between science and art, is an old and tricky subject and I shall only have time to touch on some aspects of it.

It has been said that the essence of scientific discovery is seeing an analogy which nobody has seen before. When William Harvey perceived the exposed heart of a fish as a messy kind of mechanical pump, he saw an analogy which nobody had seen before; and when King Solomon, in the Song of Songs, compared the Shulamite's neck to an ivory tower he did the same. The two discoveries seem worlds apart, yet the

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underlying psychological process follows the same pattern: a familiar object or event is perceived in a new, unfamiliar, revealing light as if a cataract had suddenly been removed. This process is basic to both the art of discovery and the discoveries of art; I have coined for it the term "bisociation," to distinguish it from the pedestrian routines of association along beaten tracks. Bisociation means a sudden leap of the creative imagination which connects two hitherto unrelated ideas, observations, frames of perception or "universes of discourse" in a new synthesis. It is usually followed by an inaudible Eureka cry which combines intellectual illumination and emotional catharsis.

The humblest sort of bisociation is the pun—two strings of thought tied together in an acoustic knot. Yet the *rhyme* is no more than a glorified pun, where sound lends resonance to meaning. Likewise, when *rhythm and meter* invade language, they carry echoes of the shaman's tom-tom and—as Yeats said—"lull the mind into a waking trance"; while in the *metaphor*, a verbal statement acquires an added dimension by the superimposition of a visual image.

Now the point I want to make is that all of these combi-native patterns which are found in artistic creativity have their equivalents in the scientist's quest. For instance, rhythmic pulsations are fundamental in the study of biology and perception; the frequency of the vibrations which reach eye and ear determine color and musical pitch. The Pythagoreans, who started the scientific adventure, regarded the cosmos as a large musical box, where the musical intervals corresponded to the distances between the planetary orbits, providing the mathematical foundation of the harmony of the spheres. Far from being materialists, they regarded all matter as a dance of numbers, and modern physics, after de-materializing matter, has reverted to the same attitude.

According to a popular misconception, the scientist's reasoning processes are strictly logical and lacking in the sensuous and visual quality of the poetic imagination. In fact an inquiry among American mathematicians revealed that nearly all of them, including Einstein, thought in terms of visual images, and not of precise verbal concepts. One of the greatest phys-

icists of all time, Michael Faraday, visualized the tensions surrounding magnets and electric currents as curves in space which he called "lines of force" and which, in his imagination, were as real as if they consisted of solid filaments. He saw the universe patterned with these curving lines and shortly after suffered an attack of schizophrenia. There is a strong affinity between the curves of force which crowd Faraday's universe and the giddy vortices in Van Gogh's skies.

However, science, as the hoary cliché goes, aims at truth, art at beauty. There seems to be a crack in Keats' Grecian urn, and its message to sound somewhat hollow; but if we look more closely, the crack tends to disappear. The artist and the scientist each projects his experience of reality into his chosen medium of expression. They do not inhabit separate universes, but occupy the two extremes of a continuous spectrum—a rainbow stretching from the infra-red of the physicist to the ultra-violet of the poet, with many intermediary ranges—such hybrid vocations as architecture, photography, chess-playing, cooking, psychiatry, or the potter's craft. There is nowhere a clear boundary where the kingdom of science ends and that of art begins; and the *uomo universale* of the Renaissance was a citizen of both.

The criteria of excellence vary of course according to the medium, but they too show continuous gradations from the *relatively* objective methods of verifying a scientific theory by experiment, to the *relatively* subjective criteria of aesthetic value. But the emphasis is on relative. Thus the same experimental data can in most cases be interpreted in more than one way—which is why the history of science echoes with as many venomous controversies as the history of literary criticism—which ought to be a comfort to all of us. In fact the progress of science is strewn, like an ancient desert trail, with the bleached skeletons of discarded theories which once seemed to possess eternal life.

The progression of art involves equally agonizing reappraisals of accepted values, criteria of relevance, frames of perception. In the last two centuries alone Europe saw the rise and fall of classicism; romanticism and *Sturm und Drang*; naturalism; surrealism and Dada; the socially conscious novel; the existen-

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tialist novel; the *nouveau roman*. In the history of painting, the changes were even more drastic. The same zig-zag course characterizes the progress of science, whether you turn to the history of medicine, or psychology, or the fundamental changes in physics from the Aristotelian to the Newtonian to the Einsteinian conception of the cosmos. The poet, the painter, the scientist, each superimposes his more or less ephemeral vision on the universe, each constructs his own biased model of reality by selecting and highlighting those aspects of experience which he considers significant and ignoring those which he considers irrelevant. The same technique of abstraction by selective emphasis is reflected in the caricaturist's cartoon, the physicist's diagram, the geographer's atlas, the stylized landscape or portrait. The technique is the same, only the media differ, and the criteria of what is relevant.

I do not wish to exaggerate: there is certainly a considerable difference, in precision and objectivity, between the methods of judging a theorem in physics and a work of art. But I must emphasize once more that there are continuous transitions between them. Moreover, the process of judging comes always *post factum*, after the creative act; whereas the decisive phase of the act itself is always a leap into the dark, a dive into the twilight zones of consciousness; and the diver is more likely to come up with a handful of mud than with a coral. False inspiration and crank theories are as abundant in the history of science as bad works of art; yet they command in the victim's mind the same forceful conviction, the same euphoria, as the happy finds which are *post factum* proven right. In this respect the scientist is in no better position than the artist: while in the throes of the creative process, guidance by truth is as uncertain and subjective as guidance by beauty.

We can now venture a step further: every valid scientific discovery gives rise, in the connoisseur, to the experience of beauty, because the solution of a vexing problem creates harmony out of dissonance; and vice versa, the experience of beauty can only occur if the intellect endorses the validity of the operation—whatever its nature—designed to elicit the experience. A virgin by Botticelli, and a mathematical theorem by Poincaré, do not betray any similarity between the mo-

tivations or aspirations of their respective creators; the first seemed to aim at "beauty," the second at "truth." But it was Poincaré who wrote that what guided him in his unconscious gropings towards the "happy combinations" which yield new discoveries was "the feeling of mathematical beauty, of the harmony of number, of form, of geometric elegance. This is a true aesthetic feeling that all mathematicians know." Many outstanding scientists have made similar confessions. "Beauty is the first test; there is no permanent place in the world for ugly mathematics," G.H. Hardy wrote in his classic *A Mathematician's Apology*. The doyen of English physicists, Paul Dirac, went even further, with his famous pronouncement: "It is more important to have beauty in one's equations than to have them fit experiment." He got the Nobel nevertheless.

Let us now turn to the opposite end of the spectrum: the novelist or poet does not create in a vacuum; his world-view is confined—whether he realizes it or not—to the philosophical and scientific panorama of his time. John Donne was a mystic, but he instantly realized the significance of Galileo's telescope:

Man has weav'd out a net, and this net throwne
Upon the Heavens, and now they are his owne . . .

Newton had a comparable impact; so of course had Darwin, Marx, Fraser of the Golden Bough, Freud or Einstein. As for Botticelli, we know little about his philosophical views, but we do know that painters and sculptors have always been guided, and often obsessed, by scientific or pseudo-scientific theories: the Golden Section of the Greeks; the geometry of perspective and foreshortening; Dürer's and Leonardo's "ultimate laws of perfect proportion"; Cezanne's doctrine that all natural form can be reduced to spheres, cylinders and cones, and so forth. The counterpart of the mathematician's apology which puts beauty before logical method is Seurat's pronouncement: "They see poetry in what I have done. No, I apply my method, and that is all there is to it."

Both sides seem to lean over backward: the scientist by confessing his dependence on intuitive hunches which guide his theorizing—while the artist values, or over-values, the abstract principles which impose discipline on his intuition.

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The two factors complement each other; the proportions in which they combine depends foremost on the medium in which the creative drive finds its expression.

But what is the nature of that drive itself and what is the motivation, the urge, the need behind it? Biologists have in recent years begun to recognize that there exists an *exploratory drive*, shared by man and the higher animals, which is as basic as the drives of hunger and sex. The hunger for experience and the thirst of stimulation seems to be as deep-rooted as hunger and thirst themselves. The exploratory drive may combine with, or enter the service of other drives—feeding, reproduction or, in humans, ambition and vanity; but in its purest form the quest is its own reward—or, as Stevenson put it, “to travel hopefully is better than to arrive.” Every great artist has an element of the explorer in him: the poet does not “manipulate words” as the behaviorist would have it, he explores the emotive and descriptive potentialities of language; the painter is engaged, throughout his life, in learning to see.

Thus the creative drive has its unitary biological source, but it can be channeled into a variety of directions. It is a blend of curiosity and wonder—where curiosity refers to its intellectual, and wonder or awe to its emotional aspect. Jointly they motivate the scientist’s and the artist’s voyages of exploration. Johannes Kepler, the astronomer, wrote of the sensation of “marvelous clarity” which enraptured him when he discovered the laws of planetary motion; and that experience is shared by every writer when a stanza suddenly falls into what seems to be its predestined pattern, or when the felicitous image unfolds in the mind. Experiences of this kind always combine intellectual satisfaction with emotional release—that quasi-mystical “oceanic feeling” in which for a brief moment the mortal self seems to dissolve like a grain of salt in the ocean. Art is a school of self-transcendence; at its best, it expands individual consciousness into cosmic awareness, as science endeavors to explain particular phenomena by laws of a general order, to reduce a particular puzzle to the great universal puzzle.

To say it again: intellectual illumination and emotional catharsis are the essence of the aesthetic experience. The first

constitutes the moment of truth, the second provides the experience of beauty. The two are complementary aspects of an indivisible process. The experience of truth, however subjective, must be present for the experience of beauty to arise; and conversely, the solution of any of nature's riddles, like that of a noble chess problem, makes one exclaim "How beautiful!"

Thus to heal the crack in the Grecian urn and make it acceptable in this age, we would have to improve on Keats' wording and translate it into computer jargon: beauty is a function of truth, truth a function of beauty. They can be separated by analysis, but in the experience of the creative act—and its re-creative echo in the beholder—they are as inseparable as emotion is inseparable from thought. Both signal, one in the language of the brain, the other of the bowels, the moment of the Eureka cry when—in the words of Carlyle—"the infinite is made to blend itself with the finite, to stand visible, as it were, attainable here."

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This brings me to my last point. In contrast to Shakespeare's "all the world's a stage" I believe that the ordinary mortal's life is played on two stages, situated on two different levels—let us call them the Trivial Plane and the Tragic Plane. Most of the time we move about on the Trivial Plane; but on some rare occasions, when confronted with death or engulfed in the oceanic feeling, we seem to fall through a stage-trap and are transferred to the Tragic or Absolute Plane. Then all at once the pursuits of our daily routines appear as shallow, trifling vanities; but once safely back on the Trivial Plane we dismiss the experiences of the other as phantasms of overstrung nerves.

The highest form of human creativity is the endeavor to bridge the gap between the two planes. Both artist and scientist are gifted—or cursed—with the faculty of perceiving the trivial events of everyday experience *sub species aeternitatis*, from the angle of the eternal; and conversely to express the absolute in human terms, to reflect it in a concrete image. Our ordinary mortal has neither the intellectual nor the

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emotional equipment to live for more than brief transition periods on the Tragic Plane. The Infinite is too inhuman and elusive to cope with unless it is made to blend itself with the tangible world of the finite. The existentialist's Absolute only becomes emotionally effective if it is bisociated with something concrete—dovetailed into the familiar. This is what both scientist and artist are aiming at, though not always consciously. By bridging the gap between the two planes, the cosmic mystery becomes humanized, drawn into the orbit of man, while his humdrum experiences are transfigured, surrounded by a halo.

Needless to say, not all novels are—or should be—“problem novels,” aiming at the reader a constant heavy barrage of the tragic and the archetypal; if they were, literature would be very monotonous indeed. But indirectly and implicitly every great work of art has some bearing on man's ultimate problems. A flower, even if it is only a modest daisy, must have a root; and a work of art, however gay, precious or serene, is in the last instance fed—however indirectly, invisibly, through delicate capillary tubes, from the archetypal sub-strata of experience.

By living on both planes at once, the creative artist or scientist is able to catch an occasional glimpse of eternity looking through the window of time. Whether it is a mediaeval stained glass window or Newton's law of universal gravity is a matter of temperament and taste.