Science and the Unexpected Universe

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A BRITISH ESSAYIST OF DISTINCTION, H. J. Massingham, once remarked perceptively that woods nowadays are haunted not by ghosts, but by a silence and man-made desolation which might well take terrifying material forms. There is nothing like a stalled train in a marsh to promote such reflections—particularly if one has been transported just beyond the environs of a great city and set down in some nether world that seems to partake both of nature before man came and the residue of what will exist after him. It was night when my train halted, but a kind of flame-wreathed landscape attended by shadowy figures could be glimpsed from the window.

After a time, with a companion, I descended and strolled forward to explore this curious region. It turned out to be a perpetually burning city dump, contributing its miasmas and choking vapors to the murky sky above the city. Amidst the tended flames of this inferno I approached one of the grimy attendants who was forking over the rubbish. In the background other shadows, official and unofficial, were similarly engaged. For a moment I had the insubstantial feeling that must exist on the borders of hell, where everything, wavering among heat waves, is transported to another dimension. One could imagine ragged and distorted souls grubbed over by scavengers for what might usefully survive.

I stood in silence watching this great burning. Sodden papers were being forked into the flames and after a while it crossed my mind that this was perhaps the place where last year's lace valentines had gone, along with old Christmas trees, and the beds I had slept on in childhood.

"I suppose you get everything here," I ventured to the grimy attendant.

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He nodded indifferently and drew a heavy glove across his face. His eyes were red-rimmed from the fire. Perhaps they were red anyhow.

"Know what?" He swept a hand outward toward the flames. "No," I confessed.

"Babies," he growled in my ear. "Even dead babies sometimes turn up. From there." He gestured contemptuously toward the city and hoisted an indistinguishable mass upon his fork. I stepped back from the flare of light but it was only part of an old radio cabinet. Out of it had once come voices and music and laughter, perhaps from the twenties. And where were the voices traveling now? I looked at the dangling fragments of wire. They reminded me of something, but the engine bell sounded.

I made a parting gesture. Around me in the gloom dark shapes worked ceaselessly at the dampened fires. My eyes were growing accustomed to their light.

"We get it all," the dump philosopher repeated. "Just give it time to travel, we get it all."

"Be seeing you," I said irrelevantly. "Good luck."

Back in my train seat the flames and the dangling wire rose up unwillingly in memory. It had something to do with an air crash years ago and the identification of the dead. Anthropologists get strange assignments. I put the matter out of my mind as I always do, but I dozed and it came back: the box with the dangling wires. I had once fitted a seared and broken skull-cap over a dead man's brains and I had thought, peering into the scorched and mangled skull vault, it is like a beautiful, irreparably broken machine, like something consciously made to be used, and now where are the voices and the music?

"We get it all," a dark figure said in my dream. I sighed and the figure in the murk faded into the clicking of the wheels.

One can think just so much, but the archaeologist is awake to memories of the dead cultures sleeping around us, to our destiny and to the nature of the universe we profess to inhabit. I would speak of these things not as a wise man, with scientific certitude, but from a place outside, in the role, shall we say, of a city dump philosopher. Nor is this a strained figure of speech. The archaeolo-

gist is the last grubber among things mortal. He puts not men, but civilizations, to bed, and passes upon them final judgments. He finds, if imprinted upon clay, both our grocery bills and the hymns to our gods. Or he uncovers, as I once did in a mountain cavern, the skeleton of a cradled child, supplied, in the pathos of our mortality, with the carefully "killed" tools whose shadowy counterparts were intended to serve a tiny infant through the vicissitudes it would encounter beyond the dark curtain of death. Infinite care had been lavished upon objects that did not equate with the child's ability to use them in this life. Was his spirit expected to grow to manhood, or had this final projection of bereaved parental care thrust into the night, in desperate anxiety, all that an impoverished and simple culture could provide where human affection could not follow?

In a comparable but more abstract way the modern mind, the scientific mind, concerned as it is with the imponderable mysteries of existence, has sought to equip oncoming generations with certain mental weapons against the terrors of ignorance. Protectively, as in the case of the dead child bundled in a cave, science has proclaimed a universe whose laws are open to discovery and, above all, in the words of one of its greatest exponents, Francis Bacon, it has sought "not to imagine or suppose, but to *discover* what nature does or may be made to do."

To discover what nature does, however, two primary restrictions are laid upon a finite creature: he must extrapolate his laws from what exists in his or his society's moment of time and, in addition, he is limited by what his senses can tell him of the surrounding world. Later, technology may provide for the extension of those senses, as in the case of the microscope and telescope. Nevertheless the same eye or ear with which we are naturally endowed must, in the end, interpret the data derived from such extensions of sight or hearing. Moreover, science since the thirteenth century has clung to the dictum of William of Ockham that hypotheses must not be multiplied excessively; that the world, in essence, is always simple, not complicated, and its secrets accessible to men of astute and sufficiently penetrating intellect. Ironically, it is in the time of our greatest intellectual and technological tri-

umphs that one is forced to say that Ockham's long-honored precepts, however well they have served man in the reduction of superstition, and in the mastery of his environment, are, from another view, merely a more sophisticated projection of his desire for order—and for the ability to control, understand and manipulate his world.

All of these intentions are commendable enough, but perhaps we would approach them more humbly and within a greater frame of reference if we were to recognize what Massingham sensed as lying latent in his wood, or what John Donne implied over three centuries ago when he wrote:

> I am rebegot
> of absence, darknesse, death:
> Things which are not.

Donne had recognized that behind visible nature lurks an invisible and procreant void from whose incomprehensible magnitude we can only recoil. That void has haunted me ever since I handled the shattered calvarium that a few hours before had contained, in microcosmic dimensions, a similar lurking potency.

Some years previously I had written a little book of essays in which I had narrated how time had become natural in our thinking and I had gone on to speak likewise of life and man. In the end, however, I had been forced to ask How Natural is Natural—a subject that raised the hackles of some of my scientifically inclined colleagues who confused the achievements of their disciplines with certitude on a cosmic scale. My very question thus implied an ill-concealed heresy. That heresy it is my intent to pursue further. It will involve us, not in the denigration of science, but rather in a farther stretch of the imagination as we approach those distant and wooded boundaries of thought where, in the words of the old fairy tale, the fox and the hare say goodnight to each other. It is here that predictability ceases and the unimaginable begins—or, as a final heretical suspicion, we might ask ourselves whether our own little planetary fragment of the cosmos has all along concealed a mocking refusal to comply totally with human conceptions of order and secure prediction.

The world contains, for all its seeming regularity, a series of surprises resembling those that in childhood terrorized us by erupting on springs from closed boxes. The world of primitive man is not dissimilar. Lightning leaps from clouds, something invisible rumbles in the air, the living body, spilling its mysterious red fluid, lies down in a sleep from which it cannot waken. There are night cries in the forest, talking waters, guiding omens, or portents in the fall of a leaf. No longer, as with the animal, can the world be accepted as given. It has to be perceived and consciously thought about, abstracted and considered. The moment one does so one is outside of the natural; objects are each one surrounded with an aura radiating meaning to man alone. It is to a universe already suspected of being woven together by unseen forces that man brings the organizing power of primitive magic. The manikin that is believed to control the macrocosm by some sympathetic connection is already obscurely present in the poppet thrust full of needles by the witch. Crude and imperfect, magic is still man's first conscious abstraction from nature, his first attempt to link disparate objects by some unseen attraction between them.

If we now descend into the early years of modern science we find the world of the late eighteenth and early nineteenth centuries basking comfortably in the conception of the balanced world machine. Newton had established what appeared to be the reign of universal order in the heavens. The planets, indeed the whole cosmic engine, were self-regulatory. This passion for order controlled by a Divinity too vast to be concerned with petty miracle was slowly extended to earth. James Hutton glimpsed, in the long erosion and renewal of the continents by subterranean uplift, a similar "beautiful machine" so arranged that recourse to the "preternatural," or "destructive accident," such as the Mosaic Deluge, was unnecessary to account for the physical features of the planet.

Time had lengthened and through those eons, law, not chaos, reigned. The imprint of fossil raindrops similar to those of today had been discovered upon ancient shores. The marks of fossil ripples were also observable in uncovered strata, and buried trees had absorbed the sunlight of far millennia. The remote past was

one with the present and, over all, a lawful similarity decreed by a Christian Deity prevailed.

In the animal world, save for the beliefs of a few hesitant thinkers, a similar web of organization was believed to exist. The balanced Newtonian clockwork of the heavens had been transferred to earth and, for a few decades, was destined to prevail in the world of life. Plants and animals would be frozen into their existing shapes, they would compete but not change, for change in this system was basically a denial of law. Hutton's world renewed itself in cycles just as the oscillations observable in the heavens were similarly self-regulatory.

Time was thus law-abiding. It contained no novelty and was self-correcting. It was, as we have indicated, a manifestation of divine law. That law was a comfort to man. The restive world of life fell under the same dominion as the equally restive particles of earth. Organisms oscillated within severely fixed limits. The smallest animalcule in a hay infusion carried a message for man, the joints of an insect assured him of divine attention. "In every nature and every portion of nature which we can descry," wrote William Paley in a book characteristic of the period, "we find attention bestowed upon even the minutest parts. The hinges in the wing of an earwig . . . are as highly wrought as if the creator had nothing else to finish. We see no signs of diminution of care by multiplicity of objects, or distraction of thought by variety. We have no reason to fear, therefore, our being forgotten, or overlooked, or neglected." Written into these lines in scientific guise is the same humanly protective gesture that long ago had heaped skin blankets, bone needles and a carved stick for killing rabbits, into the burial chamber of a child.

This undeviating balance in which life was locked was called "natural government" by the great anatomist John Hunter. It was, in a sense, like the cyclic but undeviating life of the planet earth itself. That vast elemental creature felt the fall of raindrops on its furry hide, was troubled by the drift of autumn leaves or the erosive work of wind throughout eternity. Nevertheless, the accounts of nature were strictly kept. If a continent was depressed at one point, its equivalent arose elsewhere. Whether the item in

the scale was the weight of a raindrop or a dislodged boulder on a mountainside, a dynamic balance kept the great beast young and flourishing upon its course.

And as it was with earth, so with its inhabitants. "There is an equilibrium kept up among the animals by themselves," Hunter went on to contend. They kept their own numbers pruned and in proportion. Expansion was always kept within bounds. The struggle for existence was recognized before Darwin but it was only as the indefinite sway of a returning pendulum. Life was selected but it was selected for but one purpose: vigor and consistency in appearance. The mutative variant was struck down. What had been was, what would be already existed. As in the case of that great animal the earth, of the living flora and fauna it could be said that there was to be found "no vestige of a beginning,—no prospect of an end." An elemental order lay across granite, sea and shore. Each individual animal peered from age to age out of the same unyielding sockets of bone. Out of no other casements could he stare; the dweller within would see leaf and bird eternally the same. This was the scientific doctrine known as uniformitarianism. It had abolished magic as it had abolished the many changes and shapeshiftings of witch doctors and medieval necromancers. At last the world was genuinely sane under a beneficent Deity. Then came Darwin.

At first he was hailed as another Newton who had discovered the laws of life. It was true that what had once been deemed independent creations, the shells in the collector's cabinet, the flowers pressed into memory books, were now, as in the abandoned magic of the ancient past, once more joined by invisible threads of sympathy and netted together by a common ancestry. The world seemed even more understandable, more natural than natural. The fortuitous had become fashionable and the other face of "natural government" turned out to be creation. Life's pendulum of balance was an illusion.

Behind the staid face of that nature we had worshiped for so long we were unseen shapeshifters. Viewed in the long light of limitless time we were optical illusions whose very identity was

difficult to fix. Still, there was much talk of progress and perfection. It was only later that we began to realize that what Charles Darwin had introduced into nature was not Newtonian predictability but absolute random novelty. Life was bent, in the phrase of Alfred Russel Wallace, upon "indefinite departure." No living thing, not even man, understood upon what journey he had embarked. Time was no longer cyclic or monotonously repetitious.* It was historic, novel and unreturning. Since that momentous discovery man has, whether he realizes or accepts his fate, been moving in a world of contingent forms.

Even in the supposedly stable universe of matter, as it was viewed by nineteenth-century scientists, new problems constantly appear. The discovery by physicists of antimatter particles having electric charges opposite to those that compose our world and unable to exist in concert with known matter, raises the question of whether, after all, our corner of the universe is representative of the entire potentialities that may exist elsewhere. The existence of antimatter is unaccounted for in present theories of the universe and such peculiarities as the primordial atom and the recently reported noise of the explosion of the birth of the universe, as recorded in the radio spectrum, lead on into unknown paths.

If it were not for the fact that familiarity leads to assumed knowledge we would have to admit that the earth's atmosphere of oxygen appears to be the product of a biological invention, photosynthesis, another random event that took place in archeozoic times. That single "invention," for such it was, determined the entire nature of life on this planet and there is no possibility at present of calling it preordained. Similarly the stepped-up manipulation of chance, in the shape of both mutation and recombination of genetic factors, which is one result of the sexual mechanism, would have been unprophesiable.

The brain of man, that strange green iceberg of conscious and unconscious life, was likewise unpredictable until its appearance. A comparatively short lapse of geological time has evolved a hu-

* For purposes of space I have chosen to ignore the short-lived geological doctrine of the early nineteenth century known as catastrophism, since I have treated it at length elsewhere.

manity that, beginning in considerable physical diversity, has increasingly converged toward a universal biological similarity marked only by a lingering and insignificant racial differentiation. With the rise of Homo sapiens and the final perfection of the human brain as a manipulator of symbolic thought, the spectrum of man's possible social behavior has widened enormously. What is essentially the same brain biologically can continue to exist in the simple ecological balance of the stone age, or, on the other hand, may produce those enormous inflorescences known as civilizations. These growths seemingly operate under their own laws and take distinct and irreversible pathways. In an analogous way organisms mutate and diverge through adaptive radiation from one or a few original forms.

In the domain of culture man's augmented ability to manipulate abstract ideas and to draw in this fashion enormous latent stores of energy from his brain has led to an intriguing situation: the range of his *possible* behavior is greater and more contradictory than that which can be contained within the compass of a single society, whether tribal or advanced. Thus as man's penetration into the metaphysical and abstract has succeeded, so has his capacity to follow, in the same physical body, a series of tangential roads into the future. Likeness in body has, paradoxically, led to diversity in thought. Thought, in turn, involves such vast institutional involutions as the rise of modern science with its intensified hold upon modern society.

All past civilizations of men have been localized and have had, therefore, the divergent mutative quality to which we have referred. They have offered choices to men. Ideas have been exchanged, along with technological innovations, but never on so vast, overwhelming and single-directed a scale as in the present. Increasingly there is but one way into the future, the technological way. The frightening aspect of this situation lies in the constriction of human choice. Western technology has released irrevocable forces and the "one world" which has been talked about so glibly is frequently a distraught conformity produced by the centripetal forces of Western society. So great is its power over men that any other solution, any other philosophy, is silenced. Men, unknow-

ingly, and whether for good or ill, are making their last decisions about human destiny. To pursue the biological analogy, it is as though, instead of many adaptive organisms, a single monstrous animal embodied the only organic future of the world.

Archaeology is the science of man's evening, not his midday triumphs. I have spoken of my visit to a flame-wreathed marsh at nightfall. All in it had been substance, matter, trailing wires and old sandwich wrappings, broken toys and iron bedsteads. Yet there was nothing present that science could not reduce into its elements, nothing that was not the product of the urban world whose far-off towers had risen gleaming in the dusk beyond the marsh. There on the city dump had lain the shabby debris of life: the waxen fragment of an old record that had stolen a human heart, wilted flowers amongst smashed beer cans, the castaway knife of a murderer, along with a broken tablespoon. It was all a maze of invisible, floating connections, and would be until the last man perished. These forlorn materials had all been subjected to the dissolving power of the human mind. They had been wrenched from deep veins of rock, boiled in great crucibles and carried miles from their origins. They had assumed shapes which, although material enough, had existed first as blueprints in the profound darkness of a living brain. They had been defined before their existence, named and given shape in the puff of air that we call a word. That word had been evoked in a skull box which, with all its contained powers and lurking paradoxes, has arisen in ways we can only dimly retrace.

A great and oft-quoted scientist is reputed to have once remarked that he refused to believe that God plays at dice with the universe. But as we survey the long backward course of time, it would appear that indeed He does, that the open-endedness of time is unexpectedly an essential element of His creation. Every time an infant is born, the dice, in the shape of genes and enzymes and the intangibles of chance environment, are being rolled again, as when that smoky figure from the fire hissed in my ear the tragedy of the cast-off infants of the city. Each one of us is a statistical impossibility around which hovers a million other lives that were never

destined to be born—but who, nevertheless, are being unmanifest, a lurking potential in the dark storehouse of the void.

Today in spite of that web of law, that network of forces which the past century sought to string to the ends of the universe, a strange unexpectedness lingers about our world. This change in viewpoint, which has frequently escaped our attention, can be illustrated in the remark of Heinrich Hertz, the great nineteenth-century experimenter in the electromagnetic field. "The most important problem which our conscious knowledge of nature should enable us to solve," Hertz stated, "is the anticipation of future events, so that we may arrange our present affairs in accordance with such anticipation."

There is an attraction about this philosophy which causes it to linger in the lay mind and, as a short-term prospect, in the minds of many scientists and technologists. It implies a tidiness which is infinitely attractive to man, increasingly a homeless orphan lost in the vast abysses of space and time. Hertz's remark seems to offer surcease from uncertainty, power contained, the universe understood, the future apprehended before its emergence. The previous Elizabethan age, by contrast, had often attached to its legal documents a humble obeisance to life's uncertainties expressed in the phrase, "by the mutability of fortune and favor." The men of Shakespeare's century may have known less of science but they knew only too well what unexpected overthrow was implied in the frown of a monarch or a breath of the plague.

The twentieth century, on the other hand, surveys a totally new universe. That our cosmological conceptions bear a relationship to the past is obvious, that some of the power of which Hertz dreamed lies in our hands is all too evident, but never before in human history has the mind soared higher and seen less to cheer its complacency. We have heard much of science as the endless frontier, but we whose immediate ancestors were seekers of gold among great mountains and gloomy forests are easily susceptible to a simplistic conception of the word *frontier* as something conquerable in its totality. We assume, given enough time and expenditure of energy, that the ore will be extracted and the forests computed in board feet of lumber. A tamed wilderness will subject itself to man.

Not so the wilderness beyond the stars or concealed in the infinitesimal world beneath the atom. Wise reflection will lead us to recognize that we have come upon a different and less conquerable region. Forays across its border already suggest that man's dream of mastering all aspects of Nature takes no account of his limitations in time, space, or even his own senses, augmented though they may be by his technological devices. Even the thought that he can bring to bear upon that frontier is limited in quantity by the number of trained minds that can sustain such an adventure. Ever more expensive grow the tools with which research can be sustained, ever more diverse the social problems which that research, in its technological phase, promotes. To take one single example: who would have dreamed that a tube connecting two lenses of glass would pierce into the swarming depths of our own being, force upon us incredible feats of sanitary engineering, master the plague and create that giant upsurge out of unloosened nature which we call the population explosion?

The Roman Empire is a past event in history, yet by analogy it presents us with a small scale model comparable to the endless frontier of science. A great political and military machine had expanded outward to the limits of the known world. Its lines of communication grew ever more tenuous, taxes rose fantastically, the disaffected and alienated within its borders steadily increased. By the time of the barbarian invasions the vast structure was already dying of inanition. Yet that empire lasted far longer than the world of science has yet endured.

But what of the empire of science? Does not its word leap fast as light, is it not a creator of incalculable wealth, is not space its plaything? Its weapons are monstrous, its eye is capable of peering beyond millions of light years. There is one dubious answer to this buoyant optimism: science is human, it is of human devising and manufacture. It has not prevented war, it has perfected it. It has not abolished cruelty or corruption. It has enabled these abominations to be practiced on a scale unknown before in human history.

Science is a solver of problems, but it is dealing with the limitless, just as, in a cruder way, were the Romans. Solutions to problems create problems; their solutions, in turn, multiply into addi-

tional problems which escape out of scientific hands like noxious insects into the interstices of the social fabric. The rate of growth is geometric and the vibrations set up can even now be detected in our institutions. This is what the late great biologist D'Arcy Thompson called the evolution of contingency. It is no longer represented by the long, slow turn of world time as the geologist has known it. Contingency has escaped into human hands and flickers unseen behind every whirl of our machines, every pronouncement of political policy.

Each one of us before his death looks back upon a childhood whose ways now seem as remote as those of Rome. "Daddy," the small daughter of a friend of mine recently asked, "tell me how it was in olden days." As my kindly friend groped amidst his classical history, he suddenly realized with a slight shock that his daughter wanted nothing more than an account of his own childhood. It was forty years away and it was already "olden days." "There was a time," he said slowly to the enchanted child, "called the years of the Great Depression. In those years there was a very great deal to eat, but men could not buy it. Little girls were scarcer than now. You see," he said painfully, "their fathers could not afford them and they were not born." He made a half-apologetic gesture to the empty room as if to a gathering of small reproachful ghosts. "There was a monster we never understood called Overproduction. There were," and his voice trailed hopelessly into silence, "so many dragons in that time you could not believe it. And there was a very civilized nation where little girls were taken from their parents..." He could not go on. The eyes from Auschwitz, he told me later, would not permit him.

Recently I passed a cemetery in a particularly bleak countryside. Adjoining the multitude of stark upthrust grey stones was an incongruous row of six transparent telephone booths erected in that spot for reasons best known to the communications industry. Were they placed there for the midnight convenience of the dead, or for the midday visitors who might attempt speech with the silent people beyond the fence? It was difficult to determine, but I thought the episode suggestive of our dilemma.

An instrument for communication, erected by a powerful unseen intelligence, was at my command, but I suspect, although I was oddly averse to trying, that the wires did not run in the proper direction, and that there was something disconnected or disjointed about the whole endeavor. It was, I fear, symbolic of an unexpected aspect of our universe, a universe that however strung with connecting threads is endowed with an open-ended and perverse quality we shall never completely master. Nature contains that which does not concern us, and has no intention of taking us into its confidence. It may provide us with receiving boxes of white bone as cunning in their way as the wired booths in the cemetery, but, like these, they appear to lack some essential ingredient of genuine connection. As we consider what appears to be the chance emergence of photosynthesis which turns the light of a far star into green leaves, or the creation of the phenomenon of sex which causes the cards at the gaming table of life to be shuffled with increasing frequency and into ever more diverse combinations, it should be plain that nature contains the roiling unrest of a tornado. It is not the self-contained stately palace of the eighteenth-century philosophers, a palace whose doorstep was always in precisely the same position.

From the oscillating universe beating like a gigantic heart, to the puzzling existence of antimatter, order, in a human sense, is at least partially an illusion. Ours, in reality, is the order of a time, and of an insignificant fraction of the cosmos, seen by the limited senses of a finite creature. Behind the appearances, as even one group of primitive philosophers, the Hopi, have grasped, lurks being unmanifest, whose range and number exceeds the real; this is why the unexpected will always confront us; this is why the endless frontier is really endless. This is why the half-formed chaos of the marsh moved me as profoundly as though a new prophetic shape induced by us had risen monstrously from dangling wire and crumpled cardboard.

We are more dangerous than we seem and more potent in our ability to materialize an unexpected which is drawn from our own minds. "Force maketh Nature more violent in the Returne," Francis Bacon had once written. In the end this is her primary

quality. Her creature man partakes of that essence, and it is well that he consider it in contemplation and not always in action. To the unexpected nature of the universe man owes his being. More than any other living creature he contains unknowingly the shapes and forms of an uncreated future to be drawn from his own substance. The history of this unhappy century should prove a drastic warning of his powers of dissolution even when directed upon himself. Waste, uncertain marshes lie close to reality in our heads. Shapes as yet unevoked had best be left lying amidst those spectral bog lights lest the drifting smoke of dreams, as once it did, merge imperceptibly with the choking real fumes from the ovens of Belsen and Buchenwald.

"It is very unhappy, but too late to be helped," Emerson had noted in his journal, "the discovery we have made that we exist. That discovery is called the Fall of Man. Ever afterwards we suspect our instruments. We have learned that we do not see directly." Wisdom interfused with compassion should be the consequence of that discovery, for at the same moment one aspect of the unexpected universe will have been genuinely revealed. It lies deep hidden in the human heart and not at the peripheries of space. Both the light we seek and the shadows that we fear are projected from within. It is through ourselves that the organic procession pauses, hesitates or renews its journey. "We have learned to ask terrible questions," exclaimed one thinker in the dawn of Victorian science. Perhaps it is just for this that the Unseen Player in the void has rolled his equally terrible dice. It is out of the self-knowledge gained by putting dreadful questions that man achieves his final dignity.