

THE
ATHEISM OF ASTRONOMY
A REFUTATION OF THE THEORY THAT
THE UNIVERSE IS GOVERNED
BY INTELLIGENCE

BY
WOOLSEY TELLER

*Globed from the atoms falling slow or swift
I see the suns, I see the systems lift
Their forms; and even the systems and the suns
Shall go back slowly to the eternal drift.*

—LUCRETIVS

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IN MEMORY OF MY MOTHER
ADA STURTEVANT TELLER

*And that inverted Bowl we call the Sky,
Where under crawling coop'd we live and die,
Lift not your hands to It for help—for It
As impotently moves as you or I.*

—Omar

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The universe as a totality is without cause, without origin, without end.

—KARL DU PREL (Ludwig Buchner, *Force and Matter*, p. 11).

Astronomy . . . is of all others the science which seems to present to us the most striking instance of waste in nature.

—RICHARD A. PROCTOR, *Our Place Among Infinities*, p. 40.

The universe consists in the main not of stars but of desolate emptiness—inconceivably vast stretches of desert space in which the presence of a star is a rare and exceptional event. . . . The stars move blindly through space, and the players in the stellar blind-man's-buff are so few and far between that the chance of encountering another star is almost negligible.

—SIR JAMES JEANS, *The Universe Around Us*, pp. 87, 88.

Today we know not only that there is a terrible amount of disorder in the heavens—great catastrophes or conflagrations occur frequently—but evolution gives us a perfectly natural explanation of such order as there is. No distinguished astronomer now traces “the finger of God” in the heavens; and astronomers ought to know best.

—JOSEPH McCABE, *The Story of Religious Controversy*, p. 86.

No sign of purpose can be detected in any part of the vast universe disclosed by our most powerful telescopes.

HUGH ELLIOT, *Modern Science and Materialism*, p. 39.

We are bits of stellar matter that got cold by accident, bits of a star gone wrong.

—SIR ARTHUR EDDINGTON, *New York Times Magazine*, Oct. 9, 1932.

CHAPTER I

THINGS LARGE AND SMALL

The theist and the scientist are rival interpreters of nature. The one retreats as the other advances.

—JOSEPH McCABE.¹

If the ignorance of nature gave birth to gods, the knowledge of nature is calculated to destroy them.

—BARON D'HOLBACH.²

We claim, and we shall wrest from theology, the entire domain of cosmological theory.

—JOHN TYNDALL.³

... No evidence or proof of the existence of a God has been found in the phenomena of nature, based on experience.

—CHARLES P. STEINMETZ.⁴

There is no God, it is clear as the sun and as evident as the day that there is no God, and still more that there can be none.

—LUDWIG FEUERBACH.⁵

WHEN, less than two centuries ago, the famous Laplace was asked by the Emperor Napoleon why God

1. *The Existence of God*, p. 84.

2. *The System of Nature*, p. 49.

3. The Belfast Address.

4. *Charles P. Steinmetz*, John Winthrop Hammond, p. 455.

5. Article "Atheism," *Ency. Brit.*

had not been mentioned by him in his celebrated work, "*Mechanique Celeste*," and the astronomer replied, "Sire, I have no need of that hypothesis," he uttered a truth which was fully justified by the science of his time. Astronomy today is no more in need of the god-hypothesis than it was in Laplace's day: the facts of cosmological research have done nothing if not completely demolished the last vestige of theistic interpretation. We live, on the evidence of astronomy, in a godless universe.⁶

To the average individual casually engaged in contemplating the stars, the world above him presents a perfect picture of harmonious relationships. He beholds a blue vault of exquisite splendor, in which twinkle myriads of far-distant worlds. He sees the "stately procession" of the planets, the daily rising and setting of the sun! The "beautiful order" of the heavens, the "regularity" of the seasons, the fact that our planets "do not collide," or that our moon does not "fall" into the earth or our earth into the sun, make their silent appeal for the existence of God; the warmth and light of the sun, the "nicety" with which the earth makes its revolutions "on time," the alternations of day and night, all tend to show him an "order" and a "harmony" in keeping with his theistic as-

6. "You should be more ready than any one else," said Napoleon to Laplace, "to admit that God exists, for you, more than most, have seen the wonder of creation." That atom of cruelty did not realize that it was largely because Laplace had seen so much of the heavens that he was an atheist. (See Emil Ludwig's *Napoleon*, p. 602.)

sumptions. To the astronomer, the facts point otherwise: their meanings and implications go far deeper than their surface indications, and he sees instead a purposeless universe unattended by any signs of intelligent guidance. This is because there is no superficial sky-gazing or casual observation in his study of the stars. There are, for him, enough facts in astronomy to shatter theism.

Much of our popular confusion in matters of science rests on a topsy-turvy contemplation of facts. The story is told of a professor of astronomy who, having concluded his lecture on the planetary system, called for questions from the floor. A member of his audience arose to ask him the following question: "I can understand, now that you have explained it all, how the astronomer weighs the planets and measures their distances from the sun, but what bothers me is, how did he find out their names?"

The same, or a similar, bewilderment seems to possess those who as innocently ask the question, "Who made the stars?" Quite obviously the question for thoughtful person to ask is, not "Who made the stars?" but "What made the stars?" Astronomers have a definite answer. They know not only "what" made the stars, but "what" determines their movements in space. There is no "Who" or celestial personality involved in stellar activity.

Asking an astronomer, "Who made the stars?" is very much like asking a physicist, "Who made the icicles and pretty ice-drawings on my window-pane?" The answer is no more likely to be "God" in the one

case than "Jack Frost" in the other. In educated circles the days are largely past when invisible personalities and unseen beings are supposed to have anything to do with natural phenomena. We are leaving behind us the kindergarten stage of our mental development.

Those who believe in a "supreme intelligence" in the sky overlook an important principle of physiological knowledge. "Three centuries before the beginning of the Christian era," writes the distinguished anatomist, G Elliot Smith,⁷ "some of the wise men of Greece already recognized in the brain the real organ of mind; yet it was reserved for modern times to confirm the accuracy of this early knowledge and to extend it." Accordingly, it is well here to recall the materialistic basis of mind. Thinking is as much a function of structure and organization as breathing or walking. As functions cannot exist apart from their organs, it is the height of absurdity to imagine a function like thinking existing by itself or wandering about the heavens without a material substratum. A "pure spirit" hovering over matter is pure nonsense. Thought is "immaterial" only as respiration and digestion are immaterial—we cannot see, weigh, or handle functions apart from their organs—but thinking is as material as matter itself when we consider it mechanically, that is to say, as a form of vibration and sensation in the nerve fibers of the brain and of the nervous system. Matter thinks quite as

7. "The Evolution of the Brain" in *Creation by Evolution*, p. 323.

well as it walks, and talks, and dresses for the opera; and without matter thinking is impossible. "As we understand it at present," writes George W. Bartelmez,⁸ "a word or idea comes into consciousness as a result of innumerable cortical reverberations back and forth from one cell or group of cells to another." Thought is matter in motion. A cosmic intelligent being would have to be made of matter.

Astronomers are well satisfied that stars and planets move of their own accord, or without any external stimulus of a conscious character. It is the theistic and spiritualistic muddlers of science who have injected their "God" into the picture, and made of matter a helpless hag of the gutter.

Matter is not that inert mass which vitalists and metaphysicians picture for us. Even the most subtle forms of matter possess within themselves powerful potentialities and assert themselves in terms of energy.

Every beam of light we receive from the sun carries with it definite weight, weight which, as Jeans reminds us,⁹ is "as real as the weight of a ton of coal." Every erg of energy has weight and mass.¹⁰ There is no "matterless" or "spiritual" energy, or energy existing by itself; energy is matter—matter asserting

8. "Human Structure and Development" in *The Nature of the World and of Man*, p. 468-469.

9. *The Universe Around Us*, p. 117.

10. "The essential fact is that an erg of energy in any form has a mass of 1.1.10⁻²¹ grammes."—Eddington, *Stars and Atoms*, p. 97.

itself. Energy, in every form, is always identified with and inseparable from matter; the two cannot be torn apart. The law of the "conservation of energy" embodies the conservation of matter; neither matter nor energy is ever destroyed.

Everywhere we are dealing with matter, matter in an endless round of activity, expressed in terms of energy. Radiation itself is a form of energy; and that which we call radio-activity is merely a transformation of matter from one form of energy to another. The disintegration of the nucleus of a uranium atom is followed, in time, by its transference into the nucleus of a lead atom. No matter is lost in the transition. Hence, the so-called "annihilation" of the atom consists of nothing else than the breaking up of the nucleus of one kind into the nucleus of another kind of atom. There is no destruction of matter itself; nothing is lost—there has been only a change of one atom into another. The much-talked-of (and highly misnamed) "annihilation of matter" is metaphysical moonshine, prompted by those who do not know what they are talking about or by those who mistake an atomic change for the destruction of matter.¹¹

All the high-sounding talk, but really empty gibberish, about the "downfall" of materialism rests on

11. "According to the disintegration theory of Rutherford and Soddy," writes Sir Edward Thorpe, *History of Chemistry*, vol. 2, p. 42, "the radio-active elements are forms of matter undergoing changes resulting in the formation of new forms possessing chemical and physical properties differing from those of the parent substance. . . ." Here is matter undergoing *change*, not "annihilation."

phantasies. Matter matters: it is everywhere; it cannot be destroyed by the breaking up of atoms into other atoms. It cannot be "annihilated" until some metaphysician takes a little matter and "explodes" it out of existence.¹² He can do this only in talk, or by clumsily referring to the "smashing" of atoms into electrons and protons, negative and positive particles which, besides possessing weight, are, in terms of energy, still matter.

It is highly important—essential to an understanding of astronomy—that these issues be understood. The universe—stars, meteors, clam-broth and brain cells—is made of matter. Our American philosopher Santayana does well in insisting on calling matter by its right name, as we call Smith, Smith, and Jones, Jones—and also in labeling himself "a decided materialist."

12. The materialist is waiting to see the metaphysician "annihilate" matter as thoroughly as he, the materialist, annihilates the mind, or what his spiritualistic opponents call "spirit." If the mind, as spiritualists insist, is a self-existent entity, capable of activity apart from the matter of the brain, and able to wander off by itself, a man in a state of coma, or undergoing an operation under the influence of ether or chloroform, ought to be able to witness all that transpires around him. Instead, his mind is a blank, completely non-existent during the time his brain ceases to function. His so-called "spirit" cannot survive the derangement of matter, or the suspended functioning of his brain. A few drops of prussic acid, an inhalation of gas, or a clot on the brain, will unbalance or destroy the most serene mentality. What the spiritualist calls "immortal" goes dead for hours at a time, and cannot exist even throughout the life-time of the individual. It is mind, not matter, that is destructible.

ATOMS, MEN, AND STARS

WE live in a material universe, in which we ourselves, as products of the stars, are matter "through and through." That we are matter that can think is no more remarkable than there is so much matter, outside ourselves, which never thinks at all. That matter which thinks has simply reached a certain biological stage. As C. Judson Herrick observes,¹³ "Mental processes are biological functions of the body in general and of the brain in particular in just the same sense that circulation of the blood is a function of the heart or breathing is a function of the lungs. The evidence for this is biological evidence." Man has no claim for exclusion from the world of matter. He is as much matter as the world of stars.

Our foundations of knowledge are more solid than the epistemologists would have us believe. The hazy maze of obscurities and airy abstractions into which we have been led by verbal appeal is losing its lure: our knowledge of the world is fast becoming recognized as of sensory origin. All claims to super-sensory "knowledge" rest on fraud.

Man's contact with the universe around him is a contact of matter with matter. There is nothing "spiritual" about it. He himself is all matter, surrounded by matter. Whether he is receiving impressions in the form of light from a distant star or as heat waves generated in the sun, or as any other sense percep-

13. *The Thinking Machine*, p. 250.

tions, his sensations are physical and are linked with the brain as the vibrating center. Here is thinking, or matter in motion. There is no "spiritual" world, no world of transcendental physics at work within his cerebral cavity. All concepts of a supersensual world, a world "above" matter, rest on phantastic imagery.

Astronomy would never have reached the zenith of its attainments had it listened to metaphysics. Stars are physical objects: the dream of a world made of dreams is for visionaries only. To the scientist, stars are real objects moving in the skies.

A thousand years from now science will be foretelling eclipses and weighing the stars with as much mathematical precision as it does today: our mystics cannot tell us from one day to the next what metaphysics will be teaching the day after tomorrow. The knowledge of experience is solid and compact; its definiteness is paralleled by its crystalline simplicity. Only in the realm of jumbled ideas do the reachers for rainbows find a world that transcends the evidences of their senses. Our metaphysicians cannot agree among themselves for two minutes at a time: their revelations from "above" are as hazy and shift as London fogs.

Like Voltaire's Zadig, who "knew as much of metaphysics as hath ever been known in any age, that is, little or nothing at all," our modern mystics take abstractions for realities. They will tell you where the hole of a doughnut is after the doughnut is eaten, and where the wind and waves are when the air and ocean are at rest. They talk about the "spiritual na-

ture" of the mind with even more enthusiasm than they talk about the "spirituality" of a toothache or a headache.

Those who believe that knowledge is innate or derived through channels other than experience ought to come into the world as wise as they leave it. Some of them do; but it is a poor commentary on their intellectual poverty that they go out no richer than they came in. He who finds wisdom in a world above matter, i. e., in the realm of metaphysics, is seeing visions quite as vividly as the drug addict, who can enjoy the most delightful "releases" from the bonds of "dross" matter: a hypodermic injection will give him "transports" that are as ethereal as a chapter from Bergson. But he will come back to earth, realizing that matter was behind it all. And he can become "spiritualized" again only by the use of a little more matter, even though, in his "spiritual" moments, he holds it in contempt.

And here we must take issue with the statement of Bertrand Russell¹⁴ that "matter has become as 'ghostly' as anything in a spiritualistic seance." How "ghostly" it has become may be judged by anyone who has walked complacently into a dark room and stumbled over a chair, or collided with an automobile. For most of us, matter is real. A man engaged in metaphysical reveries may talk of the "ghostliness" of matter until he talks himself out of existence. To say that matter is "ghostly" because its atoms can be

14.. *Philosophy*, p. 98; "The Structure of the Atom."

divided into smaller units is the same as saying that the Atlantic Ocean is "ghostly" because it is made up of molecules. Water does not cease to be material because it is composed of units smaller than those of oxygen and hydrogen. A sea captain in a storm, whose ship is being battered by the waves, could never be convinced that matter is "ghostly," no matter how many electrons and protons compose a particular wave. It is enough for him that these mountains of matter, in the form of water, are pounding his ship.

Those who believe in the "ghostly" qualities of matter must first show that what we call matter becomes something else when it is reduced to electrons and protons. This they cannot do. It is not enough to show us that matter can be reduced to electrons and protons; it must be shown in what way these units of the atom are not matter. Certainly they possess all the attributes of matter. As long as electrons and protons possess mass and weight they are material particles. "The mass of a proton," says Russell,¹⁵ "is about 1,835 times that of an electron: it takes 1,835 electrons to weigh as much as one proton." When, we ask, did any ghost weigh as much as that? The "ghostliness" of matter turns out to be metaphysical quibbling.

The old law as to the impenetrability of matter applies to the interior of the atom.

Not only do two electrons never travel in the same

15. *Philosophy*, p. 100.

orbit, but they never occupy at the same time the same space. An electron, far out from its nucleus and describing a large orbit, is, as Jeans says,¹⁶ "a plain material particle." The nucleus of the atom, or the proton, is material: its weight is hundreds of times that of the electron itself. The atom is composed of material units as surely as babies are composed of flesh and blood.

There is no need to talk of "empty spaces" in the atom: they exist. But a man hit with a golf-ball or an Indian club might think otherwise: it would take more than a suave assurance to convince him that what really bumped him on the cranium were innocent little electrons and protons. A lot he cares about tiny particles moving in orbits: in the language of horse-sense, he has been struck by matter. And he has felt the same thing when he strikes his finger with a hammer or gets it caught in the jamb of a door. The "ghostliness" of matter becomes a real materialization under the laws of everyday physics. We live in a world of tangible realities, composed of matter.

A bar of steel, a slab of marble, or a bit of granite are concrete forms of matter. To say that matter ceases to exist when either or all of these things are reduced to electrons and protons, is to play with words: the smallest components of matter are still matter. Theoretically and experimentally, we know that the electron and the proton are material parti-

16. *The Universe Around Us*, p. 130.

cles. Rutherford's picture of the atom is substantially that of a tiny solar system, "the heavy central nucleus playing the part of the sun and the electrons acting the parts of the planets." (Jeans¹⁷)

Our up-to-date model of the structure of the atom no more invalidates the doctrine of materialism than it invalidates the materiality and ponderosity of the stars; an atom composed of electrons and protons is as material as the early atom of the Greeks: it has gained nothing in "spirituality" nor "ghostliness" by being found to contain negative and positive charges of electricity. That it can be "divided" into particles moving in tiny orbits around a centre, like planets around the sun, means nothing more than that here again is matter in motion. The metaphysicians and mystics of our day will have to look elsewhere than to modern physics for a dismissal of matter.

All this, of course, is preliminary to a study of the stars. We can only know what the stars are, and of what they are composed, by a reference to physics. The laws of substance govern the largest as well as the smallest bodies. Stars and atoms are both matter.

Hence, the doctrine of materialism—the doctrine that matter in motion makes up the whole of existence—is at once applicable to the entire range of phenomena. It embraces the stars, circling in vast orbits, down to the tiny solar system whirling within the atom. Man stands midway between a world of enormous bodies and a world of tiny particles. And

17. *The Universe Around Us*, p. 105.

he "falls apart" the same as the stars when the "infinitesimals" shift their positions or change their configurations.

The early atom of the Greek was a tiny hard sphere, supposed to represent the least and indivisible unit of matter. There is nothing in our present understanding which prevents us from believing that far down in matter there is somewhere an indestructible unit. The fact that matter is indestructible leads to this conclusion; in no other way can we account for its eternal persistency. Break it up as we may, its total volume is the same. Nowhere is there any evidence of the "annihilation of matter."¹⁸

The "atom" of modern science is quite another thing than that which the word designated among the Greeks. It is a unit of the molecule, and is in itself a mass of units. Less "solid" than the "atom" of the Greeks, it is in every way as material. There is nothing intangible about its component parts — the electrons and protons. They give us evidence of their existence in terms of mass and weight. Those who preface their study of the stars with a glance into

18. Matter is indestructible, and all the fine-spun talk, by metaphysicians and others, about the "annihilation" of matter is verbal exercise. "We have no evidence," says A. S. Eddington, "that the annihilation of matter can occur in nature." (*Stars and Atoms*, p. 101.) No one, not even Eddington, has yet been able to talk matter out of existence. The dialectical destroyers of matter are merely walking with their heads in the clouds. "No direct observational confirmation," says Jeans, *The Universe Around Us*, p. 189, "is at present available."

physics need not trouble themselves over the "splitting" of the atom. The universe, around us and within, is as solid as before.

Nor need those who have been brought up on Newtonian and Euclidian principles trouble themselves about the much-paraded "curvature of space." "This curved space is not, it is true," writes Jeans,¹⁹ "the ordinary space of the astronomer. It is a purely mathematical and probably wholly fictitious space"—a space which, when linked with time, "is nothing but a convenient fiction of the mathematician." Real space—that in which matter extends itself in three dimensions, breadth, length, height—is the space of human experience; the formal linking of space and time being in the nature of a cryptic experiment of higher mathematics. "Real space and real time undoubtedly are distinct," says Jeans.²⁰ They are undoubtedly such when we consider that the two leading exponents of "curved space," Einstein and de Sitter, have recently seen fit to modify their expressions, and jointly affirm that the facts fit an uncurved and three-dimensional space.²¹ This is the space of Sir Isaac Newton, the space known to our boyhood days when fish and fishing-poles had three dimensions, and when we were rightly taught that parallel lines never meet. The space in which stars travel is as three-di-

19. *The Universe Around Us*, p. 72.

20. *Ibid*, p. 76.

21. "Einstein Rejects Curved Space," *Literary Digest*, May 7, 1932.

mensional as that in which cows, horses and motor-cars move.

Astronomy has suffered as much from an overdose of mathematics as from the "mirages of metaphysics" (Durant). The simplest and most obvious facts have been turned into reveries. We have been treated not only to an avalanche of impossible verbalism but to fog-producing phrases like "space bending back upon itself"—which is the same as picturing a vacuum in the act of turning a backward handspring, or nothing being distorted by a stomach-ache. The whole gamut of metaphorical license has been used to befuddle and confuse. Those who think clearly will talk and write clearly; and it will take a wholesome naturalism to clean the Augean stables of accumulated mysticism. As the late Dr. David Starr Jordan wrote to the present writer, "Perhaps one virtue of the revival of obscurantism is to wake scientific men up to popular statement of the truths with which we deal."

That astute Englishman, John Stuart Mill,²² rightly pointed out that it is the "vastness" of the universe which most impresses man. But "vastness" by itself is nothing to admire: bigness counts for nothing unless it carries with it substantial virtues. We may marvel at the towering strength and muscular development of a brawny individual, but if he behaves before us like a bully or a fool, his size is unimpressive. It means nothing to a sea-anemone that it lives in the ocean, when its movements are so circumscribed

22. "The Idea of God in Nature."

and it must thrive within such narrow limits. An ocean of worlds spinning around us are as useful as though they did not exist. Indeed, as Mill remarks,²³ in speaking of the universe, "though the vast scale of these phenomena may well excite wonder, and sets at defiance all idea of rivalry, the feeling it inspires is of a totally different character from admiration of excellence." It is the enormous power and "bigness" of the universe that cause us to pause: its activities themselves rival stupidity.

NO GLORY OF GOD, BUT APPALLING CELESTIAL WASTE

IT was the Psalmist who said, "The heavens declare the glory of God." They proclaim nothing of the sort: what they really reveal is nothing but extraordinary waste and ultimate futility. The blindly-working nature of stellar activity is everywhere apparent.

Wherever we look in the starry expanse we are faced with stupendous energy spent in the production of trivial "ends," which are like their "beginnings." Vast stores of solar energy are squandered throughout interstellar depths, while bodies needing light and heat are left in darkness and cold. Wherever we turn we are confronted with "means-to-ends" all out of proportion to the "ends" achieved, and with a consumption of time and materials which, measured by intelligent standards, borders on the criminal. Everywhere is prodigious activity wasted in boundless dis-

23. Ibid.

sipation. Untold billions of years are spent in the ceaseless revolutions of orbs only to result in a small inhabited planet and a myriad of barren and uninhabitable globes! An ocean of stars kept in endless rotation—for what? Vast continents or clusters of stars, too hot for the sustenance of living forms, move in stupendous circles in dreary monotony. Stars are born from nebulae only to pass through successive degrees of temperature and end in death. One in every three stars splits in two through excessive rotation and leads itself a merry chase as double stars circling each other. The endless grind of motion of going nowhere and arriving at nothing is the supreme accomplishment of the universe. Everywhere is the dismal picture of undirected energy spent in bat-blind futility. “We find,” writes Hugh Elliot,²⁴ “nothing but unimaginable tracts of space and time, in which move bodies by fixed laws towards ends which are wholly fortuitous, and have not the smallest relation to the advantage and requirements of man.”

From the viewpoint of utility, the motions of heavenly bodies are empty and meaningless. No one in his proper senses can discern the slightest trace of design in stellar gyrations and the ceaseless spinning of globes. Of what use is it to the human race (the so-called “end-all” of existence) to be hurled through the heavens at 18 miles a second? What good does it do any of us to be catapulted through the skies and whirled at the same time? What good does it do God’s lesser masterpieces—the toads, tarantulas and

24. *Modern Science and Materialism*, p. 39.

typhus germs—to participate in these celestial rides? Why the silly goose-chase, the merry-go-round of the spheres over such protracted periods of time?

To ascribe these aimless and senseless activities to intelligence is to insult intelligence. Only a charitable sense of humor can help one to overlook the stark stupidity of attributing these motional futilities to a guiding mind.

Some find it difficult to conceive how a rotating cloud of star dust could, without a god, evolve into our world, with all its manifold forms of life, its complex structures, its Wagnerian operas, and its Shakespearean dramas. Extremes are always striking, and when seen without their intermediate steps, appear hopelessly apart. Yet the connections between gaseous worlds and man and his sometimes more than gaseous attainments are interwoven with time: an evolution of billions of years. Man himself is an evolution from the lowest specks of life,²⁵ and his at-

25. The evolution of man from lowly forms of life is a commonplace of biology. "Struggle as we may, be as snobbish as we will," writes John M. Tyler, professor of biology, Amherst College, "we cannot shake off these poor relations of ours. . . . If we appeal from adult anatomy to embryology the case becomes all the worse for us. Our ear is lodged in the gill-slit of a fish, our jaws are bronchial arches, our hyoid bone the rudiment of this system of bones supporting the gills. Our circulation begins as a veritable fish circulation; our earliest skeleton is a notochord; Meckel's cartilage, from which our lower jaw and the bones of our middle ear develop, is a whole genealogical tree of disagreeable ancestors. Our glandula thyreoidea has, according to good authorities, an origin so slimy that it should never be mentioned in polite society." (*The Whence and Whither of Man*, p. 99.)

tainments have slowly emerged from the gropings of the jungle. Music itself is a matter of evolution from the savage tom-tom, and art in form and color finds its crude beginnings in scratches on stone and mud-daubs made on the dripping walls of caves. After all, it is not a far cry from a rotating nebula to musical notes, from "dancing atoms" to music. In spite of pretty words, the sounds of a violin are scrapings of horsehair on cat-gut: it is man, able to distinguish between pleasing and offensive sounds, who has slowly perfected melody. It does not require a miracle to develop the universe from a gaseous beginning.

Anyone who has seen the two gases, oxygen and hydrogen, before mixing would never suppose that they would produce a liquid like water: yet a combination of these two elements will result in a mixture that is distinctly different from either ingredient. If two different kinds of atoms can do this, by mixing, in the space of a moment, what can we not expect from the intermixture, and countless combinations, of 90 or more different atoms over vast periods of time? Just as the richness of our language can be developed out of 26 letters, and includes every word in the dictionary, so can the complexity of the universe be made out of the 90 or more atoms.²⁶ The facts speak

26. Life itself is an assemblage of atoms. "There is," says Sir Edward Thorpe, "no absolute distinction to be drawn between the chemistry of the inorganic and organic worlds." And, again: "There can be no reasonable doubt that the chemical processes of organic life are essentially similar to those of the laboratory. *History of Chemistry*, vol. 1, p. 128, and vol. 2, p. 134.

for themselves. Man, who himself is 75 per cent. water, can, being more than a mixture of hydrogen and oxygen, do what the ocean cannot do: weigh the stars. A nebula could easily have contained the raw material of all that exists. It was Tyndall himself who saw in matter the promise and potency of all terrestrial life.²⁷

"All the innumerable substances," writes Jeans,²⁸ "which occur on earth—shoes, ships, sealing-wax, cabbages, kings, carpenters, walruses, oysters, everything we can think of—can be analyzed into their constituent atoms. . . . It might be thought that a quite incredible number of different kinds of atoms would emerge from the rich variety of substances we find on earth. Actually the number is quite small. The same atoms turn up again and again, and the great variety of substances we find on earth result, not from any great variety of atoms entering into their composition, but from the great variety of ways in which a few types of atoms can be combined."

God-believers have assumed that because they see "order" in the universe, an intelligence must have "ordained" this "order," or "planned" things the way we see them. Our idea of "order" is necessarily derived

27. Prof. A. E. Schafer, who succeeded Tyndall as president of the British Association for the Advancement of Science, made a similar declaration: "Nothing stands between chemical elements and the phenomenon called life but the knowledge of exactly how to combine the elements." (Presidential Address, Dundee, Scotland.)

28. *The Universe Around Us*, p. 101.

from the existing conditions, whatever these happen to be; and no matter what arrangement might prevail, we would be sure to observe "order." It is in the nature of the case impossible for a thing, or even a group of things, not to bear relationship to all other things, and whatever relationship exists constitutes the "established order." No one can think of a thing which would not stand, in all of its parts, in "orderly" relationship to the whole. It is impossible to imagine a sequence of events which would not constitute "order" or which would not appear to us as "properly connected." If the sun revolved around the earth, instead of the earth around the sun, or if the earth were a disk spinning like a cart-wheel through space, instead of a globe rotating on its axis, we would recognize this as the "established order" of motion, even though it were the precise opposite of what we observe now. In brief, any combination of conditions or circumstances in which we might find ourselves would appear "orderly" to our perception, because it is the existing conditions which establish the "order."

The same, or similar, remarks hold good for the use of the word "system." Astronomers speak of our solar aggregation as a "system," not because it is intelligently laid out, but because the term designates a group of bodies in space which are moving in a particular formation, and whose activities, both individually and collectively, follow a certain degree of regularity of movement. These activities we note and tabulate under the word "system." Any group of bodies moving with regularity and in definite formation would constitute a "system," regardless of what

motions they pursued or what activities we observed. We would still be dealing with a "system" if the planets trailed behind the sun, like a company of soldiers marching in single-file formation. In fact, two stars circling each other constitute a "system." The word "system" does not denote intelligent guidance in the working of the cosmos.²⁹

Stars exist neither for themselves, nor for us, nor for the "glory of God." They exist because billions of years ago a nebulous ocean of matter broke up into parts and formed itself into stars. What happened then, we see duplicated today on an almost parallel scale in the star-forming nebulae of distant space. There is nothing more supernatural in the occurrence than in the gradual breaking up of rarified gases into globulous bodies by a process of slow condensation. This occurs through the agency known as "Gravitational Instability." "This causes any mass of chaotic gas to break up into detached condensations," writes Jeans³⁰—a purely physical manifestation. The "cause" of the stars is definitely known.

The universe, therefore, did not come into existence at the command of a Ghost. It is, in its entirety, a

29. The atheist d'Holbach was once chided by Voltaire for writing a book called the *System of Nature*. The sage of Ferney could not perceive how a non-believer in God could speak of "system" in the universe. It would have done Voltaire good if he could have observed, under a microscope, the "systematic" growth of a malignant tumor and the "systematic" break-down of living cells in gangrenous affections. Nature is always "systematic," from the spinning of stars to human putrefaction.

30. *The Universe Around Us*, p. 207.

self-contained, self-determined, independent reality, consisting of matter in an endless concatenation of physical and chemical changes. This is the message of astrophysics and astronomy. Needless to say, it is in entire conflict with the Aladdin-like nonsense taught by religion, in which a cosmic Genius or celestial Magus performs miracles under the name of God.

What we see around us in the heavens is the celestial media called matter undergoing change. Stars, suns, planets, satellites, comets, meteors are but temporary formations in the vast ocean of space. Matter alone is eternal; it changes only its forms, and the universe of heavenly bodies we see today is as surely destined to destruction as is the tiniest of living forms.

The story of astronomy presents a most imposing refutation to those who assume a supernatural origin of cosmic bodies, or who insist that celestial activities are governed by intelligence. We shall here review the evidence as it applies to stellar development and decay, with particular reference to the idea of God. And in pursuing our aim we shall keep before us the very stimulating advice of John Dewey:³¹

"The first distinguishing characteristic of thinking is facing the facts—inquiry, minute and extensive scrutinizing, observation."

31. Reconstruction in Philosophy, p. 140.

CHAPTER II

STAR DUST LOOKS ABOUT

Our studies of the universe show the uniformity of its chemical structure and generally of its physical laws. We are made of the same stuff as the stars, so when we study astronomy we are in a way only investigating our remote ancestry and our place in the universe of star stuff. Our very bodies consist of the same chemical elements found in the most distant nebulae, and our activities are guided by the same universal rules. —HARLOW SHAPLEY.¹

Just as the written life of some famous man properly commences with a portrayal of his family antecedents, so any real history of the earth should begin with the activities of the sun and the origin of its present family of planets.

—ROLLIN T. CHAMBERLAIN.²

The eye of fabled Cyclops was not even prophetic of the great telescope at Mt. Wilson, the pupil of whose eye, so to speak, is 100 inches in diameter.

—FOREST RAY MOULTON.³

To understand what has happened, and even what will happen we have only to examine what is happening.

—G. L. L. BUFFON.⁴

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1. *The Star Stuff that is Man*, N. Y. Times, Aug. 11, 1929.
 2. *The Origin and Early Stages of the Earth (The Nature of the World and of Man*, p. 31).
 3. *Astronomy (The Nature of the World and of Man*, p. 1).
 4. F. Mason's *Creation by Evolution*, p. 326.

THE study of the heavens dates back to remote antiquity and to early periods of pagan culture. As far back as the third millennium B. C., equinoxes and solstices were determined by the Chinese. This we learn from the decrees promulgated by the Emperor Yao (2300 B.C.), as recorded in the "Shu Chung," a collection of documents ancient even in the time of Confucius. In Egypt, as Agnes Mary Clerke remarks,⁵ "the curiously precise orientation of the Pyramids affords a lasting demonstration of the high degree of technical skill in watching the heavens attained in the third millennium B.C." The orbital motions of the planets were also known: "The Babylonian computers were not only aware that Venus returns in almost exactly eight years to a given starting-point in the sky, but they had established similar periodic relations in 46, 59, 79 and 83 years severally for Mercury, Saturn, Mars, and Jupiter."

The movement of celestial bodies was not unknown to the ancient Greeks. Centuries before the so-called "Savior" of man came to earth to teach his doctrines of demonology and the immediate destruction of the world, the celestial bodies had been studied by the Greeks, and a fair approximation had been reached as to the motions of the earth. Pythagoras (600 B.C.) and Philolaus (480 B.C.) taught the rotation of the earth on its axis once in every twenty-four hours. Aristarchus, a famous Greek astronomer (250 B.C.) was the first to maintain that the earth moves around the sun. "Leukippos and Demokritos," writes Sir

5. Article "Astronomy," *Ency. Brit.*

Edward Thorpe, in his 'History of Chemistry,' "explained the creation of the world as due solely to physical agencies without the intervention of a creative intelligence." These teachings, the result of pagan culture, were later obliterated by the corroding influence of Christian authority, and by the sacred writings of Hebrew tradition in which the Christians believed. "From the fourth to the thirteenth century," writes Joseph McCabe,⁶ "Christendom had completely forgotten all that the race had already learned about the stars."

The Church put every obstacle in the path of those opposed to its teachings. Roger Bacon was imprisoned. Copernicus, in fear of persecution, withheld, for twelve years, the publication of his manuscript "On the Revolutions of the Heavenly Orbs." Bruno was burned at the stake by the Catholic Inquisition, and the aged Galileo was dragged before the Holy Tribunal to abjure, under threat of torture, the propagation of a doctrine which the Christian Church pronounced false and inimical to the faith. The Aristotelian philosophy, which taught that the earth is the fixed center of the universe, bore the sanction of the Church. To question it was to go counter to papal decree and the God-inspired wisdom of popes. Besides, had not Jehovah, the God of the Bible, "made the stars also" as mere afterthoughts at the time of creation? And were there not holy texts to show that the earth existed before the sun?

Under priestly domination, ignorance abounded

6. *The Truth About Galileo*, p. 34.

throughout Christendom.⁷ Man's "immortal soul" was everything, his body nothing. Material things were of trifling significance. Stars, sun, and earth would soon be blotted out by an infuriated God, who had once drowned the world and who was now intent on judging man and bringing everlasting punishment to those who had offended him. Personal salvation alone mattered at the end of the world, when vast hordes of human beings were to be cast into lakes of eternal hell-fire and suffer with "gnashing of teeth." Here were the tidings of great joy brought by the lowly Nazarene. It was the age of faith, when thousands of angels danced on the point of a pin and the heavens proclaimed the glory of God. It was the golden age of priests.

It was not until 1608—a little over three centuries ago and a mere yesterday in the life of our world—that the first telescope was constructed (the name of its maker—Lippershey—ought to be blazoned in the memory of every man). It was destined to turn the world of traditional nonsense rightside up, and establish man's true place in the universe of stars.

The coming of the telescope marks a pivotal point

7. The ignorance of the saints was appalling. *The Catholic Encyclopaedia* (Article "Antipodes") quotes St. Augustine, a distinguished ambassador of God, as stating: "As to the fable that there are Antipodes, that is to say, men on the opposite side of the earth . . . men who walk with their feet opposite ours, there is no reason for believing it." "Christianity," remarks Draper, "had been in existence fifteen hundred years, and had not produced a single astronomer." (*Conflict Between Religion and Science*, p. 157).

in the history of human thought. Before this instrument was invented, man's insight into the stellar world around him was narrowly circumscribed by visual limitations. His eyesight was of extremely feeble range, and not until he had increased his natural vision by the aid of artificial lenses was he able to penetrate into the more distant realms of space. By thus augmenting his supposed "God-given" eyesight with powerful lenses of his own construction, he has done more in three hundred years of telescopic development to perfect his visual capacity than nature has done in all these millions of years of organic evolution.

Today, with natural vision alone, man can see, in a perfectly clear sky, only 3,000 stars. With a giant instrument of his own construction he can observe and photograph 1,500 million stars. This is half a million times as many stars as nature permits him to see with the naked eye. This is because the lens in the telescope is intelligently fashioned on scientific lines; and it has taken man, to perfect it, only a fractional part of the time which nature has taken, working blindly over millions of years, to evolve the human eye, with all its inherent weaknesses and well-known optical defects.⁸

8. Helmholtz, an outstanding authority in the field of optical science, in speaking of the human eye, remarked: "If an optician sent it to me as an instrument, I would send it back with reproaches for the carelessness of his work and demand the return of my money." (See Prof. J. B. Bury's *A History of Freedom of Thought*, p. 182).

The new door unlocked by science opened upon a vast domain of unexplored space. Man's place in the universe began to shrivel to its proper proportions. Slowly he began to realize that he and his little earth were inconsequential things in the world of stars.

The priests, the witch-doctors, and the miracle-mongers of religion had told him a different story. He was, they claimed, at the center of the universe, and the aim and end of all creation. Uncritical man believed. Providence watched over him; saints preserved him if he did the bidding of the Church. Prayers would alter events, and faith would move mountains. Had not a Jewish patriarch once made the sun stand still, and had not a prophet ascended into heaven? It was a pious pipe-dream, of course, in which the vicious hand of priestcraft and crass ignorance were everywhere in evidence.

The telescope shattered this illusion. Man shrank to the impotence of an inconspicuous speck in space, and with him shrank earth, and sun, and stars and "giant" constellations. Not one of these relatively-tiny globules or clusters in the vast ocean of the sky was really important in itself. As for the stellar universe as a whole, it, too, has shriveled to a microscopic dot; and the modern, high-powered reflector has, paradoxically as it may seem, made the universe of stars appear to us at once extremely large as well as extremely small.

It is because man is infinitesimally small that the stellar universe seems immeasurably large. In its proper proportions, it is a trifling thing in itself. Meas-

ured in terms of space, or in relation to nothingness, it shrivels to the vanishing point. "Empty Waterloo Station of everything except six specks of dust," writes Sir James Jeans,⁹ "and it is still far more crowded with dust than space is with stars." Here briefly we have a compact picture of the "glory" of the heavens as revealed by the telescope.

Now, an "Intelligence" which could do no better than to "fill" Waterloo Station with six specks of dust, after working for countless billions of years, would not be entitled to a Nobel prize for achievement; and we must look to purely blindly-working forces, inherent in matter itself, for an interpretation of phenomena. The universe is not the product of a mind.

It is estimated to have taken cosmic evolution somewhere between 10,000,000 million and 20,000,000 million years to produce our universe as we see it today, and this includes the entire period of transition from nebulae to stars and from stars to earth. It is an inconceivably vast stretch of time for the development of that which is the equivalent proportionately of six specks of dust in a great railroad terminal, and the wonder is that we look upon the "result" as in any way striking or important. It is only because we are living amid these tiny, floating specks, and that we are star-dust ourselves, that the matter is of human interest.

There is, in the religious meaning of the term, no "harmony of the spheres." "Harmony" implies a close

9. *The Universe Around Us*, p. 87.

coordination of parts and mutual interactions for common or beneficial ends. These do not exist: collisions, conflagrations, explosions, catastrophes, annihilations of cosmic bodies are of daily and hourly occurrence. The stellar depths are strewn with the debris of larger bodies—of wrecked planets and smashed satellites, of stars shattered by rotating too fast. And headed for the celestial scrapheap are the myriads of meteors that shower the heavens like rain, and enormous-tailed comets which dart aimlessly about, and burnt-out moons which spin and spin as mute reminders of beginnings that end in spinning. Added to these are the binary stars, caught by mutual attraction, and forced forever to travel around each other in senseless revolutions.

Nor is there the slightest indication of a general "plan" or uniform pattern in the structure, shape, composition and motions of heavenly bodies. There is no "uniformity" as to size, weight, temperature, density, luminosity, or placement of the stars.¹⁰ They differ in every conceivable way, like a helter-skelter of odd things thrown together in hopeless confusion. Large stars may, in some cases, weigh less than even smaller ones. This, of course, is due to their differences in density. Stars range in size from super-giants like Antares (which occupies 90,000,000 times as much

10. Thus the huge star Sirius A, with a diameter *fifty times* that of its dwarf companion Sirius B, weighs only *three times* as much as the smaller star: the latter being so densely packed that each cubic inch contains nearly a ton of matter. These are extremes. In general, the discrepancies are not so great. With temperature nearly twice that of the sun, Sirius A stands out as the most brilliant star in the sky. It is familiarly known as the Dog-star.

space as the sun) to dwarf stars like van Maanen's, which is as tiny as the earth. The distances between the stars and their nearest neighbors vary from a few million to many millions of miles. Some stars are young, some middle-aged, some old. There are vast patches in the heavens where no stars exist; others where mighty clusters are gathered, or where two lonely binary stars, far removed from the rest, whirl out their hopeless destiny. Nebulae have no well-defined outlines; and of the millions that exist there are perhaps no two alike. Nor do they all give birth to stars.

Even the solar system itself is without complete motional uniformity. The planets of our "system" are all moving in one direction—except Uranus, which moves from north to south. The satellite of Neptune moves counter to the entire system of satellites. "The most curious feature of this satellite," writes Newcomb,¹¹ "is that . . . it moves from east to west." Again, the planets differ greatly in the eccentricities of their orbits, or in the ellipses they describe. Some planets are hot, some cold. Two have nine satellites; one, four; one, two; two, one; and two have no satellites. Some are more flattened at the poles than others; each varies in respect to the inclination of its axis to the plane of its orbit. Even the orbits themselves are not placed on a level or horizontal plane with respect to one another: if we regard the earth's orbit as "horizontal," the orbits of the other planets are tipped at various de-

11. *Astronomy for Everybody*, p. 235.

grees. There is no "even keel" in the heavens. Even the earth's axis is not stable but wobbles in its rotation. "The axis of the earth does not preserve an invariable direction in space, but in a certain time it describes a cone, in much the same manner as the axis of a top spinning out of the vertical."¹²

The courses of the comets are most irregular, varying from elliptical to parabolic and hyperbolic orbits, describing the most eccentric curves in their wanderings through space. Sometimes a comet is "captured" by one of our planets, or, by coming too close to the sun, is split into fragments. Nowhere is there stability or permanency in the heavens. Nor is there a "design."

In sum, the universe as we see it is precisely what we might expect under the circumstances: an aggregation of activities that know not what they are doing nor where they are headed in their mad-hatter pace—a series of occurrences which block and trip each other at every turn, by undoing, in a single instant, what they laboriously did a moment ago: a game of building and destroying without purpose or end. And behind it all there is no sign of that ghostly being which is said to guide the Whole. "Experience," writes Hugh Elliot,¹³ "affords not the smallest trace of evidence for the existence of any spiritual entity."

12. Article "Earth," *Ency. Brit.*

13. *Modern Science and Materialism*, p. 39.

CHAPTER III

DAWN: NEBULAE AND STARS

The stately drama of stellar evolution turns out to be more like the hair-breadth escapades of the films. The music of the spheres has almost a suggestion of—jazz.

—Sir A. S. EDDINGTON.¹⁴

Each star may be considered to go through a series of changes analogous to those of a human being from birth to old age. In its infancy a star is simply a nebulous mass; it gradually condenses into a smaller volume, growing hotter . . . until a stage of maximum temperature is reached, when it begins to cool off.

—SIMON NEWCOMB.¹⁵

The stillness of the heavens is, however, apparent only, for commotion of the fiercest kind is raging on all sides. Stars are suns, and the suns are spheres of fire blazing with fury indescribable; scenes of activity so tremendous that no vehemence of tempest or tornado on earth can give the slightest idea of their fearfulness.

—J. STARK BROWNE.¹⁶

Nebulae are the birthplaces of the stars, so that each nebula consists of stars born and stars not yet born.

—Sir JAMES JEANS.¹⁷

Matter, says the spectroscope, is essentially the same everywhere, in the earth and the sun, in the comet that visits us once in a thousand years, in the star whose distance is incalculable, and in the great clouds of "fire mist" that we call nebulae.

—*The Outline of Science*.¹⁸

14. *Stars and Atoms*, p. 27.

15. *The Stars*, p. 220.

16. "The Numbers and Distances of the Stars," *The Rationalist Annual*, 1931.

17. *The Universe Around Us*, p. 69.

18. P. 37.

THE ORIGIN OF THE STARS

"CHOOSE a point in space at random," writes Jeans,¹⁹ "and the odds against its being occupied by a star are enormous." This is because relatively empty space itself makes up, by far, the major part of celestial existence.

Stars are so distant from the earth that their movements in the sky cannot be observed by the naked eye, and it is only by the aid of the most powerful telescopes that we can detect their change of relative position. From one year to another, or even from century to century, they appear as "fixed" points of light. No wonder that many of the ancients thought them immovable. Yet move they do, and at speeds that transcend the imagination. It may be stated in general that stars travel at a speed equal to 1,000 times that of an express train, one of them in particular reaching the tremendous velocity of 150 miles per second. This is the star Groombridge 1830, mentioned by Eddington.²⁰ Why they should thus speed through space when speeding will only bring them back to where they were before, why they should pursue this ceaseless, endless chase, is for the design-arguers to explain. If there is any intelligence manifested in this useless expenditure of energy, this mad pace, century after century, aeon after aeon, it is not apparent; on the contrary, it indicates a response to the blind urge of non-thinking necessity.

19. *The Universe Around Us*, p. 106.

20. Article "Star," *Ency. Brit.*

Everywhere in the heavens bodies are in motion; and they are held to their orbits by the iron hand of gravitation, with all its actions and interactions in the ever-changing field of stellar movement and positions. Nowhere is there rest. Even the great galactic system of which we form a part and which, according to Shapley's estimate, contains 100,000 million stars, rotates one revolution every 300 million years—a vast pivoting mass of incandescent bodies, whose outer rim moves at a speed of thousands of miles a second. This rotating disk of stars has turned but several times since the earth was born. What purpose, we may inquire, do such motions serve in the life of man, the so-called “end-all” and objective of existence? And how can we see in any such movements the earmarks of “design”? A moving mass that gets itself nowhere except where it was before, which takes unthinkable ages to complete an entire circle, and knows not why it moves, is undoubtedly moving by potentialities resident in the original nebulae from which these bodies were born.

The familiar rate of speed at which light travels, 186,000 miles a second (which is, incidentally, about a million times the speed of sound), gives us a faint but impressive picture of stellar distances. A star is said to be so many “light-years” away—this meaning the number of years light must travel from that particular star to reach our planet. The nearest fixed star—Proxima Centauri—happens to be $4\frac{1}{4}$ “light-years” away, so we can see how far our nearest stellar neighbor is removed from our little earth. Four

and a quarter years ago the light by which we see Proxima Centauri left this star for its journey through space.

The nearest rim of stars is about a million times more distant from the earth than the nearest planet. Venus, our next-door planetary neighbor, never comes closer than 26,000,000 miles to earth. Proxima Centauri, the nearest star, is approximately a million times more distant, or, to be a little more exact, 25,000,000 million miles. It is difficult to visualize in these figures the full significance of our petty position in space and the futility of terrestrial existence and life when measured in terms of stellar depths.

Let us take a still further jaunt into space. Far beyond Proxima Centauri, past a series of star-clusters and solitary orbs, through a veritable wilderness of worlds and empty deserts of space, lie the remote—the extremely remote—extra-galactic nebulae. “The most distant of them,” writes Jeans,²¹ “is about 140 million light-years from us.” It is the furthestmost point the human eye has seen.

The light which reaches us today from these very remote regions of space started on its lightning-like journey millions of years before Joshua is said to have made the sun stand still, or Jesus is reputed to have ascended into heaven.²² Indeed, it is certain

21. *The Universe Around Us*, p. 69.

22. A “light-year” is about 6,000,000,000,000 miles, so that any one who cares to may calculate the distance which Jesus had to travel in order to reach the nearest fixed star in his “ascension” into heaven.

that the early ancestor of Joshua and Jesus—the ape-man, *Pithecanthropus Erectus*—had not yet been born. In fact, the very earth had not even given birth to the Thunder Reptile and the mighty *Tyrannosaurus*. It was long before the coming of the Dinosaurs, when God preferred the company of reptiles to that of men.²³

Every schoolboy knows that the stars are much older than the earth, and that our little globe is a mere infant in point of time. It was, relatively speaking, born only yesterday, while the life of the stars may be measured in figures which stagger the imagination. “Time,” as Jeans reminds us,²⁴ “leaves its mark, its wrinkles and its grey hairs, on the stars, so that we can guess their ages tolerably well, and the evidence is all in favor of stellar lives, not of thousands of millions, but of millions of millions, of years.” Our earth is probably not more than 2,000 million years old,²⁵ a mere nothing in point of time when compared to the life of the stars.

The Jewish cosmologists who wrote their astron-

23. According to Lucas (*Am. Mus. of Nat. Hist. Guide Leaflet No. 70*), the Dinosaurs first appeared on the earth “some 35,000,000 years ago.” At that time, the light by which we now see the extra-galactic nebulae had already traveled over 100 million years.

24. *The Universe Around Us*, p. 81.

25. This is Jean’s figure. Charles Schuchert, professor of paleontology, Yale University, states: “No geologist today thinks that the evolution of the earth and its life could have taken place in less than 100,000,000 years. My own view as a student of historical geology is that geologic time endured about 800,000,000 years.” The earth is, cosmologically considered, very young.

omy in days of pious ignorance, and handed it along in the form of sacred literature and as divinely inspired, failed utterly to grasp the natural sequence of events. According to the so-called Mosaic account of "creation," the earth was made before the sun; the stars were a mere afterthought to the "creation" of the earth. "He made the stars also" is as little valid in astronomy today as the story of the fairy godmother in Cinderella, who turned a pumpkin into a coach, is valid in chemistry. Stars were not "made" by a Jewish Magician, nor is there any "he" involved in their development: they evolve, and their emergence from nebulous matter, by natural means, is wholly foreign to the pitifully-ignorant nursery tales hatched by religion. The author of the article on "Genesis" in the *Encyclopaedia Britannica*, Stanley Arthur Cook, does well in stating what all astronomers and geologists know, namely: "That the records of the pre-historic ages in Genesis I-XI are at complete variance with modern science and archaeological research is unquestionable."

With these facts before us, we can dismiss, as altogether trivial, those teachings of religion which picture man as important in the life of the universe or the stars as mere by-products of existence. "We can say," writes Jeans,²⁶ "that the stars have existed as such for from 5 to 10 million million years, and that their atoms may have previously existed in nebulae for at least a comparable, and possibly for a much longer, time."

26. *The Universe Around Us*, p. 326.

"As a general rule," writes Simon Newcomb,²⁷ "the incandescent heavenly bodies are not masses of solid or liquid matter, as formerly assumed, but mainly masses of gas, or of substances gaseous in their nature."

The low density of the stars, due to their gaseous nature, is another decisive factor against any concept of life on the stars.²⁸ The giant star Antares, with a diameter of 390,000,000 miles, is well suited in area for the maintenance of life on a tremendous scale, but it is so tenuous in structure that it may be compared almost to a huge vacuum. This mammoth globe of rarefied gas is so large that the sun, to equal it in size, would have to expand to more than the diameter of the earth's orbit around the sun. Antares, in fact, occupies 90,000,000 times as much space as the sun, yet offers not a single square inch of surface as a foothold for life. Of what use is such a globe, seeing that it cannot produce even a blade of grass? And it is but one of four mammoth stars, the others being the super-giants, Hercules, Ceti, and Betelgeux, all of which are gaseous and uninhabitable orbs.

Astronomers are thoroughly agreed as to the origin of the stars. The primeval chaos, or nebular mist, out of which these huge bodies evolved, must have been of extremely low density, since all the matter

27. "Astrophysics," *Ency. Brit.*

28. "In many stars the material is so inflated," writes Eddington, "that it is more tenuous than the air around us; for example, if you were inside Capella you would not notice the material of Capella any more than you notice the air in this room." (*Stars and Atoms*, p. 31.)

now observable in the stars, if scattered evenly throughout the known areas of space reached by the telescope, would form only a thin veil of unthinkable rarity. This attenuated mass of matter, representing the "batter" of future worlds, was the substance out of which all things evolved. Here again we are confronted with the great emptiness of space, in which all the matter of the universe would then be spread out in a thin cloud of star-mist. This gossamer mist would then be so thin that the molecules in it, according to Jeans, would be from two to three yards apart! How thinly these molecules would be scattered may be judged by comparing them with the compactness of the molecules in air, which, on the average, are about an eight-millionth of an inch apart.

It is futile, therefore, for the theist to think of the stars as possible abodes of life. They are terrifically hot bodies—hotter, in general, than anything we can experience on earth, or of which we can conceive. Stars range from as low as the temperature of an ordinary coal fire (one may place one's hand in the open grate if he wants to know how hot this is) up to 28,000 degrees, the estimated temperature of Plackett's Star. Obviously, life cannot exist under these thermal conditions; and when we consider the vast number of stars in the galactic system, computed by Sears as 30,000 million and by Eddington as 300,000 million, we can see the utter futility of these "burning" globes, as far as life is related to stellar activity.

CELESTIAL MECHANICS

A GREAT landmark was reached when Pierre Laplace, in 1796, published his *Système du Monde*. In this he set forth his famous nebular hypothesis, in which the birth of stars and planets was traced to a rotating nebula—an hypothesis, by the way, which entirely dispensed with God.

The nebular hypothesis of Laplace has been largely augmented or modified, rather than entirely superseded, by subsequent observation; yet to the great French astronomer is due the formation of a theory which still holds good in part, and which accounts for the formation of stars. "Apart from minor details," writes Jeans,²⁹ "the process imagined by Laplace explains the birth of suns out of nebulae; it cannot explain the birth of planets out of suns." This is because the sequence of events in the development of planets is distinct from that formulated by Laplace in respect to suns. Nevertheless, he was the Darwin of the skies, who first, in a masterly way and with a grasp of mathematics which far transcended that of many of his contemporaries, traced the evolution of heavenly bodies from a simple and widely-diffused mist, or nebula, in a state of rotation, up to the giant constellations and colossal star systems we see today. His theory, which still forms the basic outline of present-day cosmological development, falls short of explaining the origin of planets from a sun,

29. *The Universe Around Us*, p. 231.

and here we come to the tidal theory postulated by Jeans, which will be considered in due course.

Whatever particular process heavenly bodies pursued in their evolution from nebulae up to mighty constellations, one thing is tolerably certain. Stars came into existence, not at the command of a ghost, nor by a few words spoken in Hebrew, but by a process of slow condensation in the primeval chaos, consuming many billions of years. The same process may be witnessed today in what are called rotating nebulae, of which many millions exist, and is recorded on photographic plates. "These photographs," says Jeans,³⁰ "exhibit a process taking place before our eyes, which is essentially identical with that imagined by Laplace, except for a colossal difference of scale. Everything happens qualitatively as Laplace imagined, but on a scale incomparably grander than he ever dreamed of. In these photographs the primitive nebula is not a single sun in the making; it contains substance sufficient to form hundreds of millions of suns; the condensations do not form puny planets the size of our earth, but are themselves suns." This is what we witness today, and it is in deadly conflict with the theory of creation as pictured in the Bible.

Nor is there, in any concept of cosmic evolution, any need of postulating a ghostly finger twirling the stars, or starting them spinning in their orbits. No initial push, no divine "shove" is required even in the earliest stages of stellar evolution. As Jeans points

30. *The Universe Around Us*, p. 230.

out,³¹ "Stars, as soon as they come into being, are endowed with rotations transmitted to them by their parent nebula, in addition to the rotations resulting from the currents set up in the process of condensation."

From chaos to nebulae, from nebulae to stars, and from stars to planets and satellites, a steady procession of natural events occurs, unattended by deities or demons. Stars move, not because of some heavenly hand, but because of what is known as the "conservation of angular momentum." This means, as Jeans explains,³² that "rotation, like energy, cannot entirely disappear. Its total amount is conserved, so that when a nebulae breaks up into stars, the original rotation of the nebula must be conserved in the rotations of the stars." And this rotary movement is traceable to nothing more supernatural than "the existence of currents in the primordial medium" which "endow the resulting nebulae with varying amounts of rotation." Hence, by the inherent properties of motion, with which matter is endowed, the entire fabric of the universe is woven, and continues in a state of motion. There is no time thinkable when matter was at rest, or without the property of motion or of changing its position in space, whether in the form of giant stars whirling through space at a thousand times the speed of an express train or of a molecule of air traversing a tiny space at 500 yards a second,

31. *The Universe Around Us*, p. 214.

32. *Ibid.*, p. 214.

the approximate speed of a rifle bullet. Matter in motion is eternal: the vision of "dead," inert, or motionless matter stirred to sudden activity by a ghost belongs to the age of fables.

Unquestionably, motion is as much a quality or an attribute of matter as form and extension, and is as inseparable from it as either of these are from the basic substratum we call matter. Those, therefore, who, in the interest of theism, insist that there must have been a time when matter was not endowed with motion, do not even understand the law of probability. There is no more reason to suppose a time when matter was at rest, as a time when matter did not possess the attributes of form and extension. Motion is as old as matter itself, and matter is as old as time.

That matter was "originally" a dead, inert mass, incapable of motion, and received its "first impetus" from some external agency, usually thought to be intelligent, rests upon not a jot of evidence. Even the nebula from which the stars came, rare and extended as it was, must have been moved by inherent properties of its own, quite the same as matter moves to-day, without the shadow of aid from anything outside itself.

"There is no difficulty," writes Sir Robert S. Ball,³³ Director of the Cambridge Observatory, "in conceiving how a nebula, quite independently of any internal motion of its parts, shall also have had as

33. Article "Nebular Theory," *Ency. Brit.*

a whole a movement of rotation. In fact, a little consideration of the theory of probabilities will show it to be infinitely probable that such an object should really have some movement of rotation, no matter by what causes the nebula may have originated. As this vast mass cooled it must by the laws of heat have contracted towards the center, and as it contracted it must, according to the law of dynamics, rotate more rapidly."

The inherent property of matter observed in the law of gravitation—by which every particle of matter attracts every other particle inversely as the square of the distance—is the fundamental keystone of physical astronomy. On it is based the entire fabric of the heavens. The development of stars and sun, and their suspension and movements in space rest on nothing more complicated than this simple physical property of matter, which extends from the atoms in a tiny speck of dust to mighty stars weighing millions of millions of tons. The universal "law" discovered by Newton is apparent throughout the heavens as in the world of the microscope.

The wonderment which the savage or the theologian might feel in seeing heavenly bodies "hanging on nothing" or suspended midway in the sky loses its glamor once the principle of gravitation is understood. The "suspension" of bodies in a medium lighter than themselves, and traveling through space at the tremendous speed of 18 miles a second, may be readily grasped once we arrive at a clear understanding

of the agency responsible for the phenomenon. We are held to the earth, and the earth is held to the sun by this property of matter; and the moon travels about the earth and is held from a headlong plunge into space by the earth's attraction.

"There is not the slightest doubt," says Jeans,³⁴ "as to what determines the motions of the stars; it is the law of gravitation, every star attracting every other star with a force which varies inversely as the square of their distance apart . . . the mere law of gravitation, together with the supposition that the stars cannot exercise free-will as to whether they obey it or not, are enough." In a word, these moving orbs are not following an intelligent command, but are moving by inner properties of their own, in response to the iron urge of physical attraction.

NO GOD GUIDES THE STARS

MOST persons think of orbits as "nicely-planned" paths which have been "properly spaced" apart, in order that moving bodies may travel in "safety". For billions of years celestial bodies have been moving in ever-changing orbits, many of which, through the vast interplay of gravitational hold of one body on another, have led to countless collisions and the elimination of bodies. Orbits which now remain and which excite so much admiration and wonder in the eyes of the theist, on account of their "proper placing" in the heavens, are merely those which have survived the

34. *The Universe Around Us*, pp. 157, 158.

long play of time—orbits which were distant enough, and sufficiently isolated, not to conflict or interfere with one another. The natural elimination of intersecting orbits has resulted in preserving those bodies whose orbits have not crossed.

It is easy to see that orbits were never “planned”, because an elliptical course is the least safe of paths, and it is this irregularity which causes most collisions in the heavens. A circular or nearly circular orbit is “safer” for a moving body to travel in than elliptical orbit of large eccentricity, and most orbits are of the latter type. If there were “intelligence” behind the universe, all orbits would have been circular. “If all the orbits were nearly circular,” remarks Rolling T. Chamberlain,³⁵ “only a few of the separate bodies moving in them would come into collision with one another. But since the orbits are ellipses, differing much in shape and dimensions, many of the particles have opportunities of collision.” Those who admire “nicely placed” orbits are simply looking at those of which the natural spacing apart has preserved them from destruction and extinction; the others have gone to the scrap-heap.

Our universe, as theistically conceived, is a wound-up piece of mechanism, “made in the beginning” to go on forever or by an occasional re-winding or adjustment of its parts. God is ever on hand to give the stars and planets a fresh push if they lag in their

35. “The Origin and Early Stages of the Earth,” in *The Nature of the World and of Man*, p. 37.

orbits, or restore them to their courses if they get out of line and wander from their "appointed paths". It is a god-sized job, but quite easy for one who has been at it for billions of years.

All the talk of a supreme intelligence or 'mind' planning the orbits of the stars and then sitting back and watching them follow their prescribed courses is idle clatter to the ears of the scientist. There are no settled courses, no "fixed" orbits for stars; and what seems a non-varying course is, in reality, subject to the universal law of eternal change. Stars move in ever-changing orbits due to their ceaseless loss of weight through radiation and to the ever-changing "hold" which one body exerts on another. It is not likely that a star ever actually returns to the same position in space it occupied before, due to the continuous shift of heavenly bodies, both in respect to individual and mass movements and complex interplay of gravitational pull between bodies. As a matter of fact, our universe is fast thinning out, spreading itself out into interstellar space. Permanent orbits do not exist.

Nor can we, under any consideration, regard the stars and planets, as we see them today, as individually eternal. The matter of which they are composed will endure, but in different forms and in different expressions of energy. The universe is slowly "running down," exhausting itself by its tremendous outpouring of energy through radiation. There is no replacement of stellar energy, and while all matter that now exists will continue to exist in one form or

another, its powers will have been spent like so much water which, having run over a mill wheel, lies dormant in the pond. Such is Jean's picture of the ultimate fate of the universe of stars. "We are left with a dead, although possibly a warm, universe—a 'heat-death'", says Jeans.³⁶ And while the conservation of energy is a fundamental axiom of science, it does not mean that energy cannot so alter its forms of activity that it will not cease to exist in a particular form.

One thing is certain. Sun and stars cannot go on radiating energy and reducing as they do now without coming to the end of their individual existence. Eventually they must consume their entire substance by dissipation and the expenditure of their latent powers. Their energies will have then become scattered through space, and stars themselves will have then been absorbed in the vast tide of what Shapley calls the universal Drift. Man sees "fixity" and "permanency" in the stars only because his own life is so brief, because his existence, measured by the stars, is a mere blink in the darkness, a feeble flash in an eternity of time. Were he able to extend his span of life to a few billion years he would realize that the apparent "unchangeable order" and "arrangement" of the universe is a matter of never-ending change, and that there is going on continuous revolutions in the form, structure, and positions of heavenly bodies.

36. *The Universe Around Us*, p. 320.

"As eternal as the stars" is a relative rather than an actual description, since we know, as well as we know anything, that stars are born to die. Nowhere is there an exception to the universal law of formation and annihilation, birth and extinction.

It has been argued by the theist that the heavenly bodies are so nicely "guided" in space that they never collide; that their orbits are so "laid out" that each star keeps its appointed distance from all the others; that, in a word, we are confronted with the evidence of a "directing" agency keeping the stars in their courses. This confounding of the situation arising from the failure to note that the present "order" of motion in the system has been reached only after the greatest "disorder" and counterplay of opposing forces; bodies which have collided or been absorbed by others, or whose motions were counter to the general trend of motion are now no longer present or felt in the main tide of dominant motion; billions of years have eliminated the weaker modes of motion. The struggle for existence in the heavens, from nebulae to stars, and from stars to planets, is quite as deadly as anywhere else, and on a far more colossal scale. The survival of the fittest exists in the heavens as well as on earth. Even after the lapse of unspeakable billions of years, we are confronted with the evidence of innumerable catastrophes in the skies: catastrophes which upset every vestige of an "ordained" order of motion and movement. We have with us today the tell-tale wreckage of "burst" stars,

"smashed" planets and satellites, and the daily "annihilation" of heavenly bodies.

There is, on physical ground alone, nothing surprising in the fact that stars rarely collide—there are so few of them in space. And they are so thinly scattered, that the chance of their colliding or of even closely approaching each other is practically nil. If every star were reduced by scale to the size of a grain of dust, the distance between each one and its nearest neighbor would average 80 miles. The chance of stellar collision under these circumstances is at once apparent. It is because they are separated by such vast distances, and not because a celestial mind directs them where to go, that stars move in relative safety. The picture of these celestial bodies being pushed about by angels, under the watchful eye of an unseen being, is medieval nonsense. The wonder is, not that the stars do not frequently collide, but that they ever do. Yet collisions do occasionally occur, in spite of the vast distances between the stars. The number of collisions is of course relatively small, but just what one might expect in the nature of the case.³⁷ And it is only by the "side-wiping" or grazing of two stars that planets are born.

If it be urged by the theist that stars were thus "wisely" distributed at great distances apart, "in

37. "Calculation shows that any one star may expect to move for something of the order of a million million million years before colliding with a second star."—Jeans, *The Universe Around Us*, p. 88.

order" that they may not collide, it can be shown that this arrangement is a direct hindrance to the birth of planets. Planets (as we shall see later) come into existence only by the near approach of two stars, and stars, as Jeans points out,³⁸ "are so sparsely scattered in space that it is an inconceivably rare event for one to pass near to a neighbor." As a consequence, planets are exceedingly rare, for the precise reason that the chance of two stars meeting in space is so prevented by distance. The "arrangement" is bad for the production of planets.

THE ALMOST LIFELESS UNIVERSE

NOTHING is more certain than that the stars are lifeless globes. It is as unthinkable that any of them should be inhabited as that our own sun—a blazing cauldron of heat — should have human beings living upon it. Life in the universe is as nothing at all. Even in our own planetary system, tiny as it is, life is of less than pin-point significance. Of the nine planets of our system only one bears life, and that planet is among the "minor" or smaller members of the group. The larger planets, with surface areas many times that of the earth, are known to be lifeless orbs. If a mentality had anything to do with the formation of the solar system with a view to producing life, it is a mentality of a very low order. It is as though a theatrical producer or showman were to build a stage

38. *The Universe Around Us*, p. 332.

as large as the American continent to exhibit a few fleas.

Jupiter, the largest planet of our system, is about twice as massive as all the other planets put together. Yet it is devoid of life. With a diameter about eleven times that of the earth, its surface area is far more extensive than that of our little globe, and it offers itself, in point of size, as the most suitable of planets for the production of life on an enormous scale. But the "divine designer" behind it all forgot to make the planet solid enough: its density is not far from that of water. And he forgot to put this giant body close enough to the sun to keep its surface warm. From a God-believer's viewpoint the arrangement is unfortunate.

The same for Saturn, the second planet of our system in point of size, which is five times as large as all the other planets, excepting Jupiter, put together. It is of very slight density: its barrenness cannot be questioned. Its tenuity is particularly striking when we consider that Titan itself, a mere satellite of Saturn, has greater density than the huge planet around which it revolves. It is better conditioned for life, in the matter of density and solidity, than its mother planet. But Titan is small and much colder than the moon.

Obviously, these striking mal-arrangements cannot be reconciled with the idea that the universe was "made" for life; life is a mere incidental and trifling occurrence: an occurrence which has not been pre-

arranged or led up to by intelligent means, but which has been introduced only at one point among billions of barren orbs. Planets are rare exceptions in the life of the stars; an inhabited planet is a rare exception in the life of the planets, and our earth is a solitary exception among trillions of lifeless orbs. The universe, as a totality, is almost a lifeless affair. What life it has borders on zero. There is nothing here that reflects a means to an end.

Even though it could be proved that all the planets of the solar system were inhabited, it would weigh as nothing against the billions of uninhabited stars: life in the universe would still constitute but an infinitesimal part of the whole. Life, in any event, shrinks to microscopic proportions, and is like a grain of dust in a great desert sandstorm.

The barrenness of this wilderness of worlds is only too apparent to the student of astronomy. "Apart from the certain knowledge," writes Jeans,³⁹ "that life exists on earth, we have no definite knowledge whatever except that, at the best, life must be limited to a tiny fraction of the universe. Millions of millions of stars exist which support no life, which have never done so and never will do so. Of the rare planetary system in the sky, many must be entirely lifeless, and in others life, if it exists at all, is probably limited to a few planets."

How the God-believer would rejoice if he could

39. *The Universe Around Us*, p. 335.

point to 300,000 million inhabited worlds! How he would argue that life on them showed the "wisdom" and forethought of the Creator, in thus populating the universe! Instead, the facts are all against him: he is left with a universe composed largely of 300,000 million lifeless orbs. What "purpose" can he assign to these dead worlds?

"The old view that every point of light in the sky represented a possible home for life is quite foreign to modern astronomy," says Jeans.⁴⁰ "The stars themselves have surface temperatures ranging from 1650 degrees to 30,000 degrees or more, and are of course at far higher temperatures inside. By far the greater part of the matter of the universe is at a temperature of millions of degrees, so that its molecules are broken up into atoms, and the atoms are broken up, partially at least, into their constituent parts. Now the very concept of life implies duration in time; there can be no life where atoms change their make-up millions of times a second and no pair of atoms can ever stay joined together."

It is only by forgetting his place in stellar space that man can find the urge to continue his interest in things here below, for all his labors on earth are destined to be wiped out in the crash of things. Indeed, the picture drawn by the astronomer is of worlds growing, developing, and decaying before our eyes. Nothing is permanent, nothing eternal in the celestial

40. *The Universe Around Us*, p. 331.

Drift but the star-dust from which man came.⁴¹ And while the tide of time rolls on

"The stars shall fade away, the sun
Himself grow dim with age, and nature sink
In years."
—ADDISON.

Regardless of crumbling worlds, no one who believes in personal extinction need lack a proper incentive for life. In spite of the fact that he does not expect to live again, Mr. H. G. Wells goes on working more steadily than some who believe that they will receive manifold blessings in the sky. Few have done more than Wells for the entertainment and en-

41. So ludicrous is the idea that man survives death, or lives on in a conscious state by "going to heaven," that it is well to quote here a few lines from Sir John Lubbock, *Origin of Civilization and the Primitive Condition of Man*, pp. 245, 246: "A friend of Mr. Lang tried long and patiently to make a very intelligent, docile Australian black understand his existence without a body. but the black never could keep his countenance and generally made an excuse to get away. One day the teacher watched and found that he went to have a hearty fit of laughter at the absurdity of the idea of a man living and going about without arms, legs, or mouth to eat; for a long time he could not believe that the gentleman was serious, and when he did realize it, the more serious the teacher was the more ludicrous the whole affair appeared to the black." Elie Metchnikoff, past director of the Pasteur Institute in Paris, soberly remarks: "The idea of a future life is supported by not a single fact, while there is much evidence against it. . . . It is easy to see why the advance of knowledge has diminished the number of believers in the persistence of consciousness after death, and that complete annihilation at death is the conception accepted by the vast majority of enlightened persons." (*The Nature of Man*, p. 161.)

lightenment of his fellow beings, yet, says he,⁴² "I do not believe I have any personal immortality." He simply takes the common-sense viewpoint of many of the world's benefactors from Democritus and Lucretius to Burbank and Edison.

Nor will men who are men fail to conduct themselves decently because neither they nor the stars can live forever, or because there is no place of future rewards and punishments. Nobility of character can suffer nothing from a realization of facts. As Karl Vogt remarks,⁴³ "There are priests who, while defrauding the state of taxes, mount the pulpit and preach that when materialists and Darwinists do not commit all sorts of crimes, it is not from righteousness but from hypocrisy. Let them rage! They require the fear of punishment, the hope of reward in a dreamt-of beyond, to keep in the right path—for us suffices the consciousness of being men amongst men."

42. *First and Last Things*, p. 110.

43. *Lectures on Man*, p. 469.

CHAPTER IV

DAYLIGHT: THE SOLAR SYSTEM

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.

Sir ARTHUR S. EDDINGTON.¹

We know of no type of astronomical body in which the conditions can be favorable to life except planets like our own revolving round a sun. . . Only an infinitesimally small corner of the universe can be in the least suited to form an abode of life.

—Sir JAMES JEANS.²

If matter exists in the universe for the purpose of life, nature would seem to tip a hogshead to fill a wineglass, when it makes life possible only on a little planet. —Sir JOHN HERSCHEL.³

If the sun were created expressly to light and heat the earth, what a waste of energy!

—FOREST RAY MOULTON.⁴

The solar system is not the typical product of development of a star; it is not even a common variety of development; it is a freak.

—Sir ARTHUR S. EDDINGTON.⁵

1. *The Nature of the Physical World*, p. 176.

2. *The Universe Around Us*, pp. 332, 333.

3. W. H. Thomson's *Some Wonders of Biology*, p. 176.

4. "Astronomy," *The Nature of the World and of Man*, p. 17.

5. Swarthmore Lecture, 1929, *Science and the Unseen World*, p. 12.

WHOEVER has sunned oneself at the seashore or basked under the intense glare of a tropical sky is probably willing to admit that our solar orb is hot. Yet it is not long ago that a religiously-minded scientist thought that the sun might be an inhabited body, in much the same way as some persons today imagine the stars are inhabited worlds. "But little more than a century ago," writes Archibald Henderson, "a distinguished astronomer, William Herschel, actually believed it possible that the sun might be a habitable planet!" A close scrutiny of the sun helps us to understand not only the nature of this star, which is the one nearest the earth, but the constitution and make-up of many other stars in general. From our study of the sun we can picture the impossibility of life on a star.

Although the sun is nearly 93,000,000 miles from the earth, it is a quarter of a million times nearer to us than any other star; it has therefore been photographed to better advantage than any of the others; its "close-ups" reveal something more tangible than mere points of light. In dealing with the sun we are dealing with a body which is nearer to us than some of the planets and whose size transcends them all. It is the brightest and most conspicuous of all celestial objects. Photographs of the sun reveal a stupendous mass of incandescent matter in a high state of agitation, pitted with great cavernous openings into any of which our little earth could be thrust and instantly consumed.

The time is past when the sun was thought to be

inhabited. It is now classed as a typical star, with a temperature at its surface of 10,000 deg. F. Its absolute temperature is 6000 deg.⁶ Solar prominences, or giant jets of gas, shoot up like mountainous flame of fire from its surface. The average altitude of these tongues of gas is thought to be 20,000 miles. Yet, on occasion, they reach far greater heights; we are told by R. A. Sampson,⁷ Astronomer Royal for Scotland, that "Young records one which reached an elevation of 350,000 miles." This altitude is a distance equal to over 43 times the diameter of the earth. The surface of the sun is in a continuous state of convulsion due to these eruptive prominences and its boiling seas of gas. The poet Dante could well have pictured his Inferno on the sun.

The sun has been computed by Jeans to be about 8 million million years old. About 7,600,000,000,000 years ago (the figure is not fanciful, but is derived from a mathematical calculation based on solar radiation) our sun could have weighed a hundred times what it does now. It has spent, in all these aeons of time, enough energy to light and heat a billion planets like our own, had its energy been intelligently directed. But like other massive stars which "radiate away their energy, and therefore also their weight, with extraordinary rapidity" (Jeans)⁸ the sun has

6. The sun's *surface* temperature is relatively "luke-warm." The *internal* temperature is calculated by Emden and Eddington to be about 31,500,000 degrees; by Jeans, 55,000,000 degrees.

7. Article "Sun," *Ency. Brit.*

8. *The Universe Around Us*, p. 178.

been a celestial spendthrift. Millions upon millions of tons of solar energy are poured daily into desert space, and wasted in the yawning abyss of outer darkness and cold, when they could well be distributed to nearby planets.⁹ "Our own sun, which is a star," writes Harlow Shapley,¹⁰ "radiates away 360,000 million tons of energy every day, of which only 160 tons reach our planet." How much better it would be for our earth if a tiny fraction of this squandered heat were poured into the polar regions of our globe and less heat on the African and Mongolian deserts. And how the outer planets of our system now intensely cold, might benefit from a proper distribution of solar radiation.

Naturally, such an expenditure of energy without a corresponding replacement cannot go on forever, and we must look to the time when the sun's supply of heat and light will have become completely exhausted. Far distant as that time may be, it is as certain as tomorrow's sundown, and calls for the cessation of all earthly life.

Our solar system is slowly "running down". The energy of the sun is not being replaced from any

9. "The amount of the sun's heat has been estimated," says Sir Robert S. Ball, "but we receive on the earth less than one two-thousand-millionth part of the whole radiation." ("Nebular Theory," *Ency. Brit.*). And as Proctor observes in his *Our Place Among Infinities*, "all the planets together receive less than 230 millionth part; the rest is seemingly scattered uselessly through interstellar depth."

10. *The New York Times Magazine*, Aug. 11, 1929.

source of power known to science, and the sun may be likened to a gigantic furnace into which the last shovelful of fuel was stored when it evolved from a primal fire-mist. Glow it must until it has burned itself out and spent its last erg of energy in a wild debauch of cosmic recklessness and unbridled dissipation.

THE CRIMINAL WASTE OF ENERGY

THERE is nothing in this ghastly waste of energy to suggest a Supreme Stoker or Chief Engineer. Such misdirection as we see in the radiation of the sun does not reflect guidance, in any sense of the word, and would be regarded as criminal in an intelligent being.

The enormous shrinkage in the weight of the sun naturally carries with it a corresponding reduction in the gravitational hold which this body exerts on the planets of our system, and all are slowly slipping from the sun. As the hold diminishes, each planet moves a step further out into space. Our own place in the system is in no way secure, and we are actually moving away from the sun at the rate of approximately three feet every hundred years. Little as this may seem in point of terrestrial time, it spells disaster to the earth in the ticking of the cosmic clock. No angel guides the planets nor holds them to "appointed paths".

Nothing is "fixed" in the universe—not even the orbit of the earth. It is known with mathematical

certainly that we are receding from the sun, due to the latter's loss of weight by radiation and its diminishing hold on our own spinning globe. As the sun loses weight at the rate of more than 4 million tons a second, its gravitational hold is rapidly decreasing, and we are each year headed, in an ever-increasing spiral course, toward the great, yawning abyss beyond. While there is no immediate danger of our being swept into oblivion, the time will arrive when all earthly things will be doomed to perish, when the earth will be too cold to sustain life, and the finest of human thoughts will have been lost forever. Then our earth, like all things else, will have joined the billions of lifeless globes.

No one can assign the slightest reason for the rotation of the sun. By turning on its axis it cannot have "days" and "nights" like the earth, nor can its sidereal motion in space mean anything to the retinue of planets traveling with it. Whether we ever reach the remote region in space toward which the sun is headed is of no moment to the inhabitants of the earth: our earth will carry on it nothing but the frozen remains of what were once living beings.

By means of spectral analysis we are able to determine the chemical constitution of the sun as accurately as if this huge globe had been lifted bodily into a gigantic laboratory and examined in a test-tube. Each element in a gaseous state emits its own wave of light, and by examining the solar spectrum, we are able to determine the precise character of the sun's constitution. The presence of such elements as

carbon, oxygen, sodium, calcium, hydrogen, helium, iron, nickel, copper, and zinc in the sun indicates the close affinity of solar and terrestrial compositions. There is indeed no element on the earth that has not been found in the sun, or from which all earthly substances are not derivatives. The earth's kinship to the gaseous body about which it revolves, and from which it was extracted long ago, is as complete as our own bodily kinship to the inorganic substances of which the earth is composed. Both earth and man are made of matter from the sun, and our very bodies contain atoms that once existed in the sun. We are, as Shapley points out, children of a star. The spectroscope has established our "blood-relationship" to the sun.

Astronomy has helped to establish the entire chemical unity of the universe. Light from the most distant stars shows us that the matter which composes them is identical with that which we find near at hand. Iron in the blood and phosphorus in the bones are the same as those found on distant worlds. By means of the spectroscope the element helium was first discovered on the sun; twenty-seven years afterward it was discovered on the earth. When, in 1868, the astronomer Lockyer made the initial discovery, the element was appropriately named from the Greek word "helios", meaning sun; its discovery over a quarter of a century later by Sir William Ramsay, a Scottish chemist, showed it to be a terrestrial element as well. The element extracted from a rare

mineral of the earth was the same as that which Lockyer detected on the rim of the sun.

The fact that the planets of our system, as well as their attending satellites, travel in orbits which do not cross or overlap one another has frequently been cited as evidence of a presiding "intelligence". Only a god, says the theist, could have assigned these bodies to their "appointed" paths. The argument is amusing to the atheist. Intersecting orbits are in the nature of things impermanent, since they could not possibly survive a collision of bodies traveling in these orbits. What we see in the heavens today are those bodies in motion which time has spared from the countless collisions of the past, and whose orbits did not conflict by overlapping one another. Orbits which did intersect have perished long since in the crash of colliding bodies. In our own system today we have the telltale remains of a smashed planet (the asteroids) and a smashed satellite (the rings of Saturn), each of which, by describing an orbit too near a larger body, was smashed to bits in the early days of the solar system, when the orbits of the planets and the satellites were not as regular or as highly stabilized as they are now. Even the orbits existing today, after 200 million years or so since our planetary system was born, are not entirely stabilized, and tiny bodies like the asteroids are still wandering far afield from the areas where they properly belong. Two of the asteroids, Delporte and Reinmuth, are so far out of their natural places in

the swarm, that the latter wanders close to the earth, and is sometimes nearer to us than Venus itself.

When we come to the smaller members of the system, the meteors, which describe very definite orbits around the sun, we meet with actual collision and the breaking of poorly "established" orbits. "A great many meteors," writes Prof. Palmer H. Graham of New York University, "have been shown to move in swarms around the sun in elliptical orbits very similar to those of comets. Occasionally the earth in its orbit crosses the path of one of these swarms and we see a so-called meteoric shower." Here before our eyes is an actual meeting of bodies through the crossing of two orbits: the earth and the meteors have met in collision.

The fact that the planets of the system are not traveling in the same orbital plane as the sun—the planetary orbits are slightly tilted with respect to one another and greatly tilted with respect to the equatorial plane of the sun—has called forth admiring comments from believers in God, yet no one explains why. The fact that the orbits of the planets are tipped at slightly different angles from one another means nothing to the solar system; the planets themselves would still receive the same amount of light and heat if they traveled in the same plane. The truth of the matter is that the tipping of these orbits is without significance, except as it throws light on the tidal origin of planets. The difference in the general orbital plane of the planets and the orbital

plane of the sun is due to natural circumstances rather than to the wisdom of God: the planets as a group are still traveling in the same orbital plane as the tidal arm which was extracted from the sun when the planets were formed. Were the orbital planes of the sun and planets symmetrical, or identical, religionists would still credit their deity with wisdom. God receives praise for making things alike and for making them different.

THE PLANETS TESTIFY AGAINST THEISM

PLANETS are born, not from nebulae, as are the stars, but from the stars themselves. In the Tidal Theory postulated by Jeans, they come into existence by the passing of two stars within three diameters' distance of each other. The larger of the two passing bodies exerts a gravitational pull or wrench on the gaseous surface of the smaller star, and, by thus causing a tidal eruption, draws out a long, cigar-shaped filament of gas. This in time condenses into globes, each of which becomes a planet revolving about the star from which it was drawn. Our earth is a planet, and so are the other members of the solar system, Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto, all of which were literally yanked from the sun 2,000 million years ago.

Now planets are extremely few in number, and their scarcity is due to the fact that stars seldom approach to within the required distance to produce a

group of planets.¹¹ Shapley¹² calls the formation of our solar system "a lucky accident," while Eddington, no less than he, recognizes the purely fortuitous nature of the occurrence. "Even in the long life of a star," says he,¹³ "encounters of this kind must be extremely rare. The density of distribution of stars in space has been compared to that of twenty tennis balls roaming the whole interior of the earth. The accident that gave birth to the solar system may be compared to the casual approach of two of these balls within a few yards of one another. The data are too vague to give any definite estimate of the odds against the occurrence, but I should judge that perhaps not one in a hundred millions of stars can have undergone this experience in the right stage and conditions to result in the formation of a system of planets."

The facts, for those who believe in "design," ought to be quite otherwise. Life, if "planned" for the earth, has been reached by the most round-about and time-wasting process, and has depended, for its inception, on the casual encounter of two out of 300,000 millions of stars. The process does not resemble a carefully laid out course of action; and an engineer working in this haphazard manner to reach a desired end would be examined for sanity.

11. "Collisions, or even tidal encounter, between two stars must be a rare event. A star in its motion is likely to have a collision with another star about once in a million million million years." Harold Jeffreys, *The New York Times*, May 3, 1931.

12. *The New York Times Magazine*, Aug. 11, 1929.

13. *The Nature of the Physical World*, p. 177.

Planets, from a God-believer's attitude, ought to be more numerous than the stars, since they are the only bodies in space (other than satellites) which cool and solidify to a point where life becomes possible. The stars, as we have already seen, are intensely hot, incandescent bodies, gaseous at the surface and perhaps liquid at the center, and wholly incapable of sustaining life. Only a trifling number of planets have evolved from the stars, and of the nine planets within our system, only one is definitely known to possess life. Here, it seems, we have a single life-bearing body in a super galaxy of 300,000 million dead orbs. Obviously, life in the universe is restricted to a microscopic point in space, and is as important to the cosmic wastes as a pope's bull is to the solar system, or the ravings of a maniac are to the distant nebulae in Orion.

Considering, therefore, the round-about "means-to-an-end" by which the earth came into existence, we can do nothing else save smile at the absurdity of the idea that a celestial being first formed the sun, in order that, millions of years after, he might leisurely extract a tiny world like ours, with all its teeming forms of life pulsating and breeding only that they may continue their pitiless slaughter of one another. The battle of life is not a Quakers' meeting or a child's picnic. Shelley's picture of blood-stained priests

"Making the earth a slaughter-house"
is as nothing compared to the ruthless slaughter by tooth and claw now going on in all parts of the world,

and which the theist asserts was instituted by intelligence.¹⁴ If theism were true, God would be more cruel than Moloch himself, and lower in the scale of mental depravity than the monster Frankenstein. The astronomer, gazing at billions of lifeless globes, can "thank his stars" that these make up the bulk of celestial existence. It is fortunate that the planets are few.

"If you try to imagine, as nearly as you can," wrote Schopenhauer,¹⁵ "what an amount of misery, pain and suffering of every kind the sun shines upon in its course, you will admit that it would be much better if, on the earth as little as on the moon, the sun were able to call forth the phenomena of life; and if, here as there the surface were still in a crystalline state."

It is not alone the world of living things which the cosmic "order" tramples under foot and ruthlessly neglects; the sun in its course looks down with stolid indifference on the slow abandonment of its planetary dependents, each of which is slowly slipping away; and drags with it its helpless brood of young ones, which even now, after millions of years of solar radiation, are as ill-kept and undernourished as the poor-

14. A butcher-bird impaling its victim on a thorn, or a lion killing a gazelle, or a cat clawing a mouse, or a tick feeding on the eye of a fowl, or an intestinal worm eating in the entrails of a priest are as much a part of the cosmic "order" as stars moving in space, and are a part of the "divine plan" which theists say exists.

15. *Studies in Pessimism*, p. 3.

est of offsprings. Planets are stricken with either chronic heat-strokes or chronic chilblains—too much sunlight or not enough—until one wonders whether the calorific powers of the sun are not something which is flaunted in mockery by the sun to make sport of the malnutrition and rickets of its children. The planetary system is far from being a well-cared-for whole, or one in which the integral workings are “suitably arranged.”

One can readily satisfy oneself on this point. Whether we examine the planets in respect to their individual characteristics as to suitability (or unsuitability) for life; whether in respect to orbits, distances, motions, or the like, we are at once struck with the disorderly arrangement of the system. There is an “order” of motion only in the sense that the same disorderly movements repeat themselves. The same bunglings occur again and again.

Whoever examines our solar system with a view to finding “fitness” in the arrangement will soon discover that it is anything but “fit.” Indeed, it would be difficult to rearrange the planets with the idea to greater unfitness. Their positions in space are bad. So are their rotations and revolutions, and the general “lay-out” of their orbits.

Take, for example, the “placing” of the planets in regard to their distances from the sun. Most of them are either too near or too far away to sustain life. The inner planets are too hot, the outer planets too cold. The Divine Wisdom which placed Mercury “smack-up” against the sun and left Pluto far out in

the cold must have been actuated by a sardonic (or satanic) sense of humor. Either this or he was inexcusably indifferent to the consequences which these positions impose. The sunny side of Mercury has a temperature which no life could stand; that of Pluto a temperature at which air and other gases would be frozen solid.

So poorly "timed" is the rotation of Mercury on its axis with its revolution around the sun that this planet forever presents the same face to the sun. As a consequence, there is an eternal "day" of intense heat on the one side and an eternal "night" of intense cold on the other: one side blistered forever under the direct blast of the sun, the other left in complete darkness and cold. If there were inhabitants on the planet, they would have to choose between scorching to death on the sunward side and freezing to death on the other.

Most planets of our system travel in such extended orbits that their "years" are many times our own. It takes Pluto, for example, 250 years to make a complete trip around the sun. This planet has not yet made an entire revolution of the sun since the United States was born. It is impossible to find in this arrangement anything that savors of "design." A planet so far removed from its solar luminary, or central source of heat, cannot, by any stretch of the imagination, be traveling in an orbit "laid down" by intelligence. It is traveling in that far-flung orbit because it was the outmost condensation in the tidal-arm extracted from the sun when our system of planets was

formed. Its position in space is not due to design.

Even the earth itself, which is the only life-sustaining sphere in our system, travels in an orbit which is poorly "laid out" for a planet bearing life: its source of heat is not at the center of the orbit, but at one foci. As a consequence, the earth, in making its annual circuit of the sun, does not travel at a uniform distance from the sun, the distance between perihelion and aphelion being about 3,000,000 miles. The result is an irregular distribution of heat in the course of the year. This variation in the heat supply to the earth, apart from causing temperature upsets, is responsible for many meteorological disturbances.

Again, in their rotations on their axes, planets display the most striking departures from anything resembling "purpose" in their movements. The farther a planet is located from the sun the faster it rotates—a fact which is wholly out of keeping with the best results to be obtained for the reception of solar radiation and the heating of the planet. Venus, a planet very close to the sun, rotates so slowly that each of its "days" and "nights" is several weeks long; Saturn and Uranus, both distant planets and therefore very cold, rotate so rapidly that each has "days" and "nights" of only ten hours' duration. The long "days" of the nearby planets and the short "days" of the distant planets are the very reverse of what they should be: the outer, or distant, planets ought to rotate more slowly than the inner planets. With slower rotations, the colder planets would be able to absorb more heat during the course of a longer "day," and those close

to the sun, by rotating more rapidly and thereby having shorter "days," would not be exposed, for entire weeks as is Venus, to the concentrated rays of the sun.

Of the nine planets of our system, only one is heated with a moderate degree of uniformity to life; yet who can say that our earth is to be admired for a sensible adjustment in the matter of temperature? As a lighting and heating system our sun has all the potentialities to take care of billions of planets: it cannot, because of mal-arrangements external to itself, take care of even the present group of nine. A furnace which has the stupendous power of the sun and yet fails so dismally in properly distributing its heat cannot be regarded as the work of an engineer.

NO ARCHITECT OF THE SOLAR SYSTEM

TELEOLOGISTS, a class of word-juggling mystics who are forever seeing "wisdom" where there is none and who try to explain the universe in terms of a presiding intelligence, have sought to show that while eight out of nine of our planets support no life, some of them may later do so, when they have moved to more suitable distances away from the sun. In a word, God, while neglecting them now, is looking to the future habitability of these planets. Kant advocated the idea, and it has been preached ever since by a whole host of the defenders of God.

The entire argument puts the deity in a ridiculous light, for Mercury, which is the hottest and most insufferable of all planets, is moving away from the sun

at the painfully slow rate of not more than a few feet a century, and at this less-than-snail-like pace would hardly be conditioned for life in several billion years. A comet can travel through space at the rate of hundreds of miles a second; and a presiding mind interested in the development of life on Mercury, ought to be able to accelerate the speed of the planet better than this. The obvious conclusion is that there is no "mind" interested in the matter.

As for Venus, it is mathematically certain that this planet, at the rate it is going, would have to keep moving away from the sun for the next one to two million years, before it would have a mean temperature equal to that of the earth. This is rather slow moving for a planet guided by "intelligence," or an agency which is supposedly aware of what it is doing.

Nor is there any hope for Mars.¹⁶ Even now, the temperature of this planet is much lower than that of the earth and it is becoming colder with each passing year. If there is no life there now—and the evidence is distinctly against it—what chance is there of its surface becoming habitable as the planet grows colder in its movement away from the sun?

As for the outer or more distant members of the system, these are yearly becoming more frigid, and the expectation that Jupiter, Saturn, Uranus, Nep-

16. "Even at the equator the temperature falls below freezing point at sunset. If we accepted the present determinations as definitive we should have some doubt as to whether life could endure the conditions."—A. S. Eddington, *The Nature of the Physical World*, p. 173.

tune, or Pluto will ever support life is as hopeless as that of a cake of ice floating toward the arctic region will ever bring forth rose bushes or orange blossoms. They are already intensely cold worlds, and destined to become still colder as they move away from the sun. "There can be neither seas nor rivers on their surfaces," writes Jeans,¹⁷ "since all water must be frozen into ice, neither can there be rain or water-vapor in their atmospheres."

There is no evidence that life exists on any planet other than our own, and there is much evidence of a definite character that life, as we know it here, does not exist elsewhere in the universe.¹⁸ By life we mean, of course, life as it is embodied in red-blooded men and women and life in its familiar higher forms—not hypothetical beings who thrive in white heat temperatures and flaming furnaces of gas, or who build churches and thank God at hundreds of degrees below zero. We are concerned here with neither asbestos-skinned beings nor fanciful ones composed of ice.

It is certain that all the other planets of the solar system—with the possible exceptions of Venus and Mars—are either too hot or too cold to sustain life, or are governed by conditions that would preclude

17. *The Universe Around Us*, p. 21.

18. The author is not discussing here the possibility of plant life existing on Mars or on some other planet. Theists are not primarily concerned as to whether or not God reserved a whole planet for the raising of vegetation. If he did, he probably made enough grasshoppers and plant-lice to go with it.

the possibility of life. We shall here examine each planet in turn.

Mercury is so close to the solar orb that lead would melt on its surface. The temperature on the side facing the sun has been figured at 662 degrees Fahrenheit. "The other half of the planet's surface," says Jeans,¹⁹ "eternally dark and unwarmed, is probably colder than anything we can imagine."

Venus, with each of its days and nights several weeks long, alternates between bitterly cold temperatures at night and roasting temperature by day. "At present no reasonable ground exists," writes S. H. Parkes,²⁰ "for the supposition that Venus is an inhabited globe." And Jeans asserts²¹ that "The evidence, for what it is worth, goes to suggest that Venus, the only planet in the solar system outside Mars and the earth on which life could possibly exist, possesses no vegetation and no oxygen for higher forms of life to breathe."

As for Mars, its possibilities for the sustenance of life are largely nullified by a variety of unfavorable conditions, among which is the matter of atmosphere. Atmosphere it has, but its oxygen content is about 15 per cent of ours. Temperature drops to below freezing point at the equator, following sundown. Its general temperature is colder than ours. The alleged "canals" on Mars, supposed by the astronomers Schiaparelli and Lowell to have been the work of Martian

19. *The Universe Around Us*, p. 22.

20. *Unfinished Worlds*, p. 74.

21. *The Universe Around Us*, p. 335.

engineers, turn out to be not canals at all. As Jeans puts it,²² they "have not survived the test of being photographed." And again: "There is no definite evidence of life, and certainly no evidence of conscious life, on Mars—or indeed anywhere else in the universe."

All the outer planets, of course, are intensely frigid orbs. Neptune is wrapped in eternal cold, with an estimated temperature of -220 degrees Centigrade. Jupiter, Saturn, and Uranus, with respective temperatures of -150 , -150 , and -170 degrees, have extremely low temperatures. In fact, as Jeans points out,²³ "all the major planets are very cold indeed." "These planets," writes F. R. Moulton,²⁴ "are all very tenuous, probably being entirely in a gaseous state, and therefore not in a condition to support life."

"We have reason to believe," says H. Spencer Jones, Astronomer Royal of England ("The Listener," June 16, 1938), "that Jupiter is entirely covered with an ice-layer several thousands of miles thick. Outside this is the dense poisonous atmosphere, a few thousand miles in depth. . . . The clouds in the upper layers of atmosphere consist probably of droplets of liquid ammonia."

As for Pluto, the furthestmost planet from the sun, it is necessarily a bitterly-cold world—far colder even than Neptune itself. Its immense distance from the

22. *The Universe Around Us*, p. 334.

23. *The Universe Around Us*, p. 21.

24. "Astronomy" in *The Nature of the World and of Man*, p. 12.

sun (calculated to be at aphelion 4,620,240,000 miles) permits it to receive only 1/2500 as much solar heat as that received by the earth. "The temperature," writes Simon Newcomb,²⁵ "must be very low there—too low for life to exist. From Pluto the sun would appear only as a point of light." "It is at least certain," remarks Prof. Lucien Rudaux,²⁶ "that on this globe lost in the frozen solitudes of outer space the temperature must be near absolute zero, which is 459 degrees below the zero of our family thermometer, so low that certain gases, like oxygen and nitrogen (the air we breathe), would be changed to a solid state." Any thought of life existing under these thermal conditions is out of the question.

The attempt of religionists to link the existence of these frozen worlds with a heavenly "plan" or "design" is drivel to a scientist. The five outer planets of our system, Jupiter, Saturn, Uranus, Neptune and Pluto, comprise by far the greater surface area of the entire system of planets. If ever, in religious language, there were "god-forsaken" worlds, they are these planets left in outer cold; and the theist presents a God with five out of the nine planets of the solar system freezing on his hands. Of the four other planets, one, as we have seen, is blistering under the full blast of the sun, two possess little or no oxygen for the higher forms of life to breathe, and one, our earth, may occasion a smile when considered in the

25. *Astronomy for Everybody*, p. 201.

26. *The American Weekly*, Feb. 7, 1932.

light of "design." Under every kind of evidence, the entire solar system is a first-class "flunk."

Carefully considered, the universe is anything but "well put together." There is hardly a third-rate mentality which could not, after a few minutes' thought, devise a plan for the better working of the cosmos.

The tremendous wastage of solar energy would be stopped, and the conserved energy of the sun would be made to do service where it is now badly needed. Billions of sunbeams would not be wasted on the Gobi and Sahara deserts, but would be diverted to the polar regions instead. Light would be so placed in the heavens that it would illuminate all parts of the earth at once. Our globe would be evenly heated, and a mild temperature would prevail from pole to pole. There would be no extremes of heat and cold: no equatorial Africa sweltering under the terrific heat of the sun nor polar regions locked in eternal ice.²⁷ Planets would be so "placed" in their distances from the sun that they would be neither too hot nor too cold to support life. Mercury and Venus, now too close to the sun, would be moved further out; Jupiter, Saturn, Uranus, Neptune, and Pluto would be

27. Rear-Admiral Richard E. Byrd, in describing the desolate character of the two polar regions, writes: "The Arctic Ocean, monotonously flat, treacherous in its power and shifting surface; the Antarctic, immobile, appalling in its grandeur and silence, a mighty mausoleum for the dead land hidden beneath its snow. . . . Here [in the Antarctic] is a vast area as big as the United States and Mexico combined that has never sustained a human race, as far as we know." (*New York Times*, June 8, 1930.)

moved further in. Mercury would be so timed in rotating on its axis that it would not forever present the same side to the sun. The major, or larger, planets of our system would not be abandoned as cold, barren orbs, but their surface areas cultivated. Energy would not be wasted in shooting comets and meteors through space, or in spinning the whole galactic system like a huge merry-go-round once in every 300,000,000 years. In a word, all the senseless, time-wasting play of cosmic motion would be stopped. Energy, of which there is enough to turn galactic systems around, would be put to useful purposes.

And what would intelligence not do in respect to correcting the faulty tilting of the world's axis? "In the well-known inclination of the axis of the earth towards the plane of its orbit, known by the name of the angle of the ecliptic, which is the cause of the change of the seasons, many perceive a design of heaven intended for our welfare," writes Ludwig Buchner.²⁸ "But they do not consider that they are confounding effect and cause, and that our organization would most probably be different were the inclination of the ecliptic different or non-existent. Besides, this very angle of the ecliptic, the object of such mistaken praise, does not even seem to be in any way conducive to our advantage; and if it were in our power to change this slope of the axis of the earth towards the plane of the earth's orbit, we should most certainly do it and thereby bring about a greater

28. *Force and Matter*, p. 111.

equality in the seasons. For if the earth's axis were perpendicular to its orbit, there would be in our latitude, for instance, a perpetual spring, calculated in all probability to lengthen human life."

Our little earth now remains to be considered as a place of habitation. Two-thirds of its surface is covered with water, and, as some one has jocosely remarked, is more suitable for raising fish than human beings. Only two strips of temperate zone encircle the earth; the rest of its surface is divided between two wide expanses of polar region and a burning equatorial belt. Man either freezes or swelters, or lives in fluctuating temperatures of dangerous extremes. Nowhere is there a celestial thermostat at work to give us a decent average temperature throughout the globe. In a thermatic sense there is no intelligence manifested in the way our earth is heated.

SATELLITES DISPROVE DESIGN

WHAT may be said for the heating, may also be said for the lighting system of our planet. Only half the earth's surface can be lighted by the sun at one time. According to the Bible, the moon was made to "rule" the night. Imagine your own city, or town, or your own reading-room at night depending on the illumination of the moon. Without Edison's electric light, our nights would be long, dreary affairs, spent either in complete darkness or in the feeble light of the moon. As for the sun, with candle power enough to

light a billion worlds, it cannot even reach the so-called "ends" of the earth and give the Eskimo light for more than six months of the year, let alone, through its stupendous power, melt the great ice-packs and snow-barriers of the polar regions.

As an abode for life, our earth is, by the nature of its rotundity, a poorly shaped body. On account of the curvature of its surface, only one side of it can be illuminated at a time, and, even though it rotates on its axis, it is impossible for the sun to warm and illuminate the entire half exposed to its rays. The direct rays of the sun are unnecessarily severe at points on and near the equator, where men must swelter and slave under the burning heat of a tropical sky, while the Eskimo must be content with the few glancing sun-rays which reach the polar areas. While vast regions of land around the south pole are buried under perpetual deposits of ice from 2,000 to 10,000 feet thick (report of the Byrd Expedition), the Sahara and Gobi deserts must wilt under the terrific heat of the sun. In such an arrangement there are no signs of an intelligent distribution of light and heat. If the superintendent of a building were to freeze tenants in one part of the structure and roast others almost to death, he would not be praised for his handling of the heating plant, nor would he be thought particularly intelligent if he kept some of them in total darkness half the year.

The alternations of day and night or of light and darkness, which are believed by some to be beneficial to man, are really detrimental in part, since they

shorten, by many years, the narrow span of his conscious existence. A man of sixty who has slept an average of eight hours daily will have lived only forty years of his life in a conscious condition. The alternations of day and night reduce man's wakeful moments considerably: a third of his life is spent in mental oblivion. It is quite easy to conceive an arrangement by which our world might be properly lighted and heated, where there would be no lost years spent in unconsciousness and where man would be safe from the horrible visitations of floods and cyclones and the other cruel hazards of life.²⁹ But none of these things are considered in the birth and formation of worlds.

Our satellite, the moon, is a cold, barren orb, which shines by the reflected light of the sun. Nearer to us than any other body, it has been photographed to excellent advantage. Without rivers or seas, it is a burnt-out cinder in space. Volcanic craters are plainly visible, but there are no signs of those conditions which are essential to the maintenance of life. "No

29. Referring to the earthquake of Lisbon in 1775, Edward Hull, in his *Volcanoes: Past and Present*, p. 221, states: "The inhabitants had no warning of the coming danger. . . . In the course of about 6 minutes, 60,000 persons perished." Edward Greenly (*The Earth, Its Nature and History*, p. 23) writes: "The destructiveness of volcanoes to man and his works is well known. . . . On May, 8, 1902, at 7:50 A. M., the Pelee volcano in Martinique broke out with a roar which was heard 100 miles away, and an avalanche of red hot dust wiped out the city of St. Pierre, with its 30,000 inhabitants, in less than one minute."

trace of water or of an atmosphere," writes George Forbes,³⁰ "has been found on the moon. It is possible that the temperature is too low . . . the moon seems to be dead." Its habitability is out of the question. "Life," remarks Simon Newcomb,³¹ "in the form in which it exists on our earth, requires water at least for its support, and in all its higher forms air also. We can hardly conceive of a living thing made of mere sand or other dry matter such as forms the lunar surface." The fantastic stories of life on the moon belong to the realm of pure fiction. "We cannot suppose it to be inhabited," writes Garrett P. Serviss,³² "at least by any forms of life familiar to us on the earth."

Of what use, then, is this cold, dismal world, with its volcanic craters fifty miles wide and its bleak mountain ranges, moving perpetually around us? And why should there be phases of the moon, varying by degrees from a thin, crescent-shaped strip of light reflected on its surface to an occasional "full" moon thirteen times a year? If the moon, as God-believers insist, was "intended" to illuminate the night, it is a distinct failure, since the greater part of its time is consumed in reflecting only narrow strips of feeble light and sometimes no light at all! An arc light which varied as much in intensity as the moon could not be depended upon to light a back alley. The

30. *Astronomy*, p. 109.

31. *Astronomy for Everybody*, p. 127.

32. *Astronomy in a Nutshell*, p. 154.

teleologist who sees "design" where there is none should explain what "purpose" is served by the moon other than to raise huge tidal waves on the earth and drown people in floods. The moon is a mere "drag" on the earth. It does not support life itself, and its senseless revolutions around us are quite in keeping with the whole futility of cosmic movement.

Again, why, if its movements in space are guided by intelligence, should the moon eclipse the sun? Why should its orbital "adjustment" be so badly timed as to bring this satellite between the earth and its luminary and blot out light? A total, or even partial eclipse of the sun is a mere case of the moon "getting in the way."

The earth is a better "moon" to its own satellite than the moon is to us. As a reflector of sunlight, the earth gives to the moon better illumination at night than we receive from the moon. Earthlight is ten times brighter than moonlight, and an observer on the moon would see the earth as a "moon" possessing ten times the surface and ten times the brilliancy of the lunar orb. But as there are no observers on the moon, our earthlight shines to no advantage and is lost on a dead world—another example of reverse order in the "scheme" of celestial "intelligence." The feeble character of moonlight may be realized by recalling that full moonlight is only $1/500,000$ that of sunlight.

As with the moon, so with the other satellites of our system, all of which are equally useless. Not one in all the twenty-six which encircle the planets is

known to be inhabited. Their sole "function" in space is to whirl incessantly around their parent bodies in aimless revolutions. If there is "wisdom" in this, and in the general character of satellites, it is for some one to explain.

Why should Mars be attended by two ridiculously small satellites, each of which has a diameter of seven miles (Newcomb),⁸⁸ and which are as useless to Mars as two apples would be hovering over the city of Boston? Why should Saturn be attended by flattened rings—the remains of a shattered satellite? Why should Jupiter and Saturn have nine moons each, and Neptune only one? Why this uneven distribution if satellites are essential to planets? Indeed, why should there be any satellites at all, seeing that planets which do not possess them get along the same as those that do? And where, in the "placing" of these bodies, is the so-called "harmony" of the spheres about which we hear so much? Jupiter itself has more satellites than Mercury, Venus, Earth, Mars, Uranus and Neptune put together. And two of these planets have none at all.

Of what use, it may be asked, are the asteroids—that group of midget planets, or tiny worlds—that lie scattered midway between the minor and major planets of the solar system, or at a point where, under Bode's law, a planet ought to be? They number thousands, and only four of the entire aggregation are known to have greater diameters than 100 miles. This

33. *Astronomy for Everybody*, p. 188.

swarm of miniature worlds revolving around the sun are mere globules in comparison to the size of the earth, the largest being Ceres, with a diameter of only 480 miles.

Their origin is well known. They are the shattered remains of a single giant body, or, as Jeans puts it,³⁴ "the broken fragments of a primeval planet." Why a planet with a celestial engineer in charge should have broken into thousands of pieces is something for the theists to explain. The asteroids are the floating debris of a shipwrecked planet which, in all probability, moved too close to the danger zone of the giant planet Jupiter, and was shattered to bits under the law of Roche's Limit. "Physically," writes Garrett P. Serviss,³⁵ "they are most insignificant bodies, their average diameter probably not exceeding 20 miles, and some are believed not to exceed ten." Their bulk, as Serviss points out, would hardly furnish enough gravitational pull to hold a man to the surface, and one might at will step off lightly into space. The thought of any of these globes being inhabited by human-like beings may be readily dismissed.

COMETS AND ASTEROIDS SERVE NO PURPOSE

NO one in his proper senses can ascribe the slightest use to the existence of comets. For ages they have served no other conceivable "purpose" than to frighten

34. *The Universe Around Us*, p. 242.

35. *Curiosities of the Sky*, p. 256.

people out of their wits. History records the terror-stricken condition of whole populaces at the approach of these "ominous" visitors in the sky.³⁶ They are, in themselves, disintegrating bodies, which, according to Newcomb, are wasting themselves away through progressive dissipation. Entire dissolution has been reached by several well-known comets.

One might reasonably inquire why comets possess tails hundreds of millions of miles long.³⁷ And why should these celestial visitants carry a dangerous stream of particles often resulting in meteoric showers? There is no answer here but that found in the blind urge of undirected forces. It would be difficult to conceive of anything more lacking in "purpose" than these bodies burning up their substance in an age-long grind of skyrocketing through space.

The eccentric behavior of comets offers very clear proof against the thought that they are pursuing "fixed" or predetermined courses laid down by intelligence. These sensitive bodies are so low in density that they are frequently deflected from their paths, and switch violently into new orbits. The curves

36. When Halley's comet appeared in 1456, "it struck terror into all people," wrote John W. Draper. "From his seat, invisible to it, in Italy, the sovereign pontiff, Calixtus III, issued his ecclesiastical fulminations; . . . in vain were all the bells in Europe ordered to be rung to scare it away; in vain was it anathematized; in vain were prayers put up in all directions to stop it." (*History of the Intellectual Development of Europe*, vol. II, pp. 253-254.)

37. "The great comet of 1843 had a tail 200,000,000 miles long." (*The Outline of Science*, vol. I, p. 36).

which they describe are anything but "orderly"; they vary from time to time, and it is not unfrequent for a comet to be captured by passing too near a larger body. In such cases the old orbit ceases to exist and the comet starts out afresh in a new orbit. If it comes too close to a larger body, its fate is sealed: it is disrupted into fragments. Two comets have been actually seen to break into two, and a third to divide into four, parts. The breaking up of these bodies by sudden and violent action does not bespeak an intelligent control.

Were we really to believe in a heavenly engineer, there would be no need to speak of stellar cataclysms. All would be serene and in good working order. The facts are the reverse.

He who thinks there are no catastrophes in the skies knows little of stellar activities. The flattened rings of Saturn and the tiny asteroids are the respective remains of a damaged moon and a smashed planet. A star which rotates too rapidly will burst, as Jeans put it,³⁸ "like an overdriven fly-wheel, into parts of nearly equal size." Why this should happen under the "guiding hand" of a Celestial Engineer is for some one other than the atheist to explain. "Spectroscopic binary and multiple systems are the relics of stars which have broken up through excess of rotation, and they do not in the least resemble the solar system." This "excess of rotation" spoken of by Jeans ends in nothing more imposing than the split-up of

38. *The Universe Around Us*, p. 228.

a star and the two parts circling each other. "Apart from this," says Eddington,³⁹ "no regular plan of further development is known." The two stars are simply left to carry on the "god-planned" process of chasing each other.

The heavens are strewn with the wreckage of stellar wastage and conflagrations. The vast ocean of the sky is filled with derelicts, not in twos and threes, or even in baker's dozens, but by the billions. Meteorites are the rubbish of larger bodies. They swarm like fish in the sea, and on a clear summer's night may be seen as "shooting-stars." "It is estimated," says the "Outline of Science,"⁴⁰ "that between ten and a hundred million meteorites enter our atmosphere and are cremated every day."

Not all meteorites are cremated by passing through our atmosphere, but fall as huge stones from the sky. The largest of these plunge headlong to earth and bury themselves in deep pits. One which has been recovered weighs $36\frac{1}{2}$ tons.⁴¹ Others, splintered into fragments, fall as showers of stones. There are on exhibit in the American Museum of Natural History in New York specimens from some 500 of the 700 meteorites which are known to have fallen throughout the world. Among the principal features of the collection are 2000 or more individual masses from

39. Swarthmore Lecture, 1929, *Science and the Unseen World*, p. 11.

40. Vol. I, p. 35.

41. This is "Ahnighito," the largest meteorite in the world, brought from Greenland by Commander Peary in 1897.

the stone shower which occurred when a large meteorite exploded near Holbrook, Arizona, in 1912.

The hurling of these "rocks" from heaven, either as single pieces or as showers of stones, does not reflect the slightest consideration for the safety of life; it is hardly conceivable that such barrages as these can be construed as the gentle "love-taps" of a heavenly Father. It is only another incident of the blind-working activities of outer space. No one in his right mind would think of throwing confetti like this around.

Nor are meteoritic showers particular as to when or where they strike. "They occur," writes Lazarus Fletcher,⁴² keeper of minerals, British Museum, "at all hours of the day and night, and at all seasons of the year; they favor no particular latitudes. The number of stones which reach the ground from one fire-ball is very variable. In each of the two Yorkshire falls only one stone was found; the Guernsey County meteor yielded 30; at Toulouse, as many as 350 are estimated to have fallen; at Hessle, over 500; at Knyasinya, more than 1000; at L'Aigle, from 1000 to 2000; at both Pultusk and Mocs no fewer than 100,000 are estimated to have reached the earth's surface. The largest single mass seen to fall is one of those which came down at Knyahinya, Hungary, in 1866, and weighed 547 pounds."

Doubtless unnumbered trillions of these stones fall into the seas and on desert and forest wastes, but this

42. Article "Meteorite," *Ency. Brit.*

is not out of consideration for man, but rather because barren tracts of water and land make up the larger areas of the globe. It is equally true they fall in inhabited portions of the world. But whether on sparsely- or densely-populated centers, it is certain that these "pot-shots" from heaven are not guided by intelligence. They are as little "directed" in their courses as the stars and planets themselves. And these of course are not "guided" at all.

It would be superfluous to enter further into a consideration of conflagrations: they are sweeping the skies daily and on a far more stupendous scale than is generally supposed. Enough has been said to indicate the torrential storm of iron that sweeps through outer space and bombards our atmosphere daily with the fury of a thousand whirlwinds.

We hear much of what is called the "music of the spheres," but this music, as Eddington points out, more closely resembles "jazz." It is anything but harmonious or symphonic in result and has all the blind-staggers and jerkiness, and even the harsh raspings of an instrument out of tune. To some of us the "melody" of the universe is more like the squealing of pigs.

The rotation of Uranus is all out of harmony with that of other members of the system. This planet turns, not from west to east, but in a north-to-south motion. As a consequence the planet, if it had life on it, would offer the most abominable conditions in the matter of seasons. The tipping of its axis is all out of alignment with the rest. Not only is this planet

askew, but the two outer satellites of Jupiter "are unlike the great majority of the members of our system in that they revolve from east to west." (Newcomb).⁴³ And, as if this were not enough, we find two of the satellites of Uranus traveling in orbits which "are nearly perpendicular to the orbit of the planet." (Newcomb).⁴⁴

Lastly, consider the orbital abnormalities of our own satellite, the moon. So poorly "timed" is it, in its rotation on its axis with its revolution around the earth, that it always presents the same face to us. The same may be said of the planet Mercury, one face of which is eternally facing the sun, and whose inhabitants, if it had any, would have to swelter forever under the scorching beams of the sun. And what may be said about those erratic wanderers, the comets, whose orbits cover such staggering distances in space? It is the contention of the theist that these bodies were "made" to be admired. Yet Donati's Comet, which was last seen in 1858, will not return till about 2000 years. If any reader missed seeing it then, he may simply wait until it comes again.

Truly, as Buchner remarks,⁴⁵ "never has been found the slightest trace of an arbitrary finger ordaining the spheres of the heavens and appointing the courses of the earth, the suns, and the comets."

43. *Astronomy for Everybody*, p. 175.

44. *Ibid.*, p. 191.

45. *Force and Matter*, p. 105.

CHAPTER V

DARKNESS: THE ETERNAL DRIFT

Brief and powerless is Man's life; on him and all his race the slow, sure doom falls pitiless and dark. Blind to good and evil, reckless of destruction, omnipotent matter rolls on its relentless way; for Man, condemned today to lose his dearest, tomorrow himself to pass through the gate of darkness, it remains only to cherish, ere yet the blow falls, the lofty thoughts that ennoble his little day, disdaining the coward terrors of the slave of Fate.

—BERTRAND RUSSELL.¹

When I look up at the starry heavens at night and reflect upon what it is that I really see there, I am constrained to say, "There is no God." . . . It is not the works of some God that I see there. . . . I see no lineaments of personality, no human traits, but an energy upon whose currents solar systems are but bubbles.

—JOHN BURROUGHS.²

If we turn from contemplating the world as a whole, and, in particular, the generations of men as they live their little hour of mock-existence and then are swept away in rapid succession; if we turn from this, and look at life in its small details, as presented, say, in a comedy, how ridiculous it all seems! It is like a drop of water seen through a microscope, a single drop teeming with infusoria; or a speck of cheese full of mites invisible to the naked eye. How we laugh as they bustle about so eagerly, and struggle with one another in so tiny a space! And whether here, or in the little span of human life, this terrible activity produces a comic effect.

—ARTHUR SCHOENHAUER.³

The world is a comedy for those who think, a tragedy for those who feel.

—HORACE WALPOLE.⁴

1. *Mysticism and Logic*, p. 56.
2. *The Light of Day*, p. 164.
3. *Studies in Pessimism*, p. 24.
4. Will Durant's *The Story of Philosophy*, p. 375.

THE MYTH OF THE PRESIDING MIND

JEANS assures us⁵ that "nature abhors accuracy and precision in all things," yet in the face of this rational declaration tells us that "the Great Architect of the Universe now begins to appear as a pure mathematician." The remark itself could conveniently serve as a sop for the religious. It is difficult to conceive a pure "mathematician" who would be so stupid as to abhor "accuracy" and "precision" in his work, since these are the first requirements of a mathematical mind. And an "architect" whose work showed as much abhorrence of "accuracy" and "precision" as nature does could be neither a "great" architect nor a "pure" mathematician. Jeans is wrong: there is no Mathematician nor Architect in the clouds.

Dr. Herbert Dingle,⁶ honorary secretary of the Royal Astronomical Society of England, quite properly takes Jeans to task: "It would not be difficult to show, I think, that in some respects his metaphysical conclusions are actually at variance with his scientific beliefs." Dr. Dingle is a bit too conservative. Jeans' metaphysical beliefs, in every respect, are hopelessly at odds with his scientific conclusions.⁷

5. *The Mysterious Universe.*

6. *Science and Human Experience.*

7. The fault is not Jeans' but belongs to metaphysics. Michelet describes metaphysics as "the art of befuddling one's self methodically." (Durant's *The Story of Philosophy*, p. 397) This definition has never been surpassed.

One must be careful at all times to distinguish between the scientific knowledge and the religious utterances of men of science. Even some of our most brilliant workers in the field of knowledge frequently carry around with them, not only rudimentary organs, but rudimentary thoughts. The fact that a man is an illustrious authority in the field of science is no guarantee that he cannot utter at times his fair share of unmitigated nonsense.

Thus Sir James Jeans—whose astronomical facts and figures are freely referred to in the course of this work, and for whom the author entertains a lively respect—sees behind the phenomena of the universe a presiding mind, or a cosmic Mathematician. Being an excellent mathematician, Sir James easily endows his deity with the attributes of his own profession. It is an understandable procedure for one who believes in God. The pious artist, with pallet and brush, who looks at a rainbow or a glorious sunset, will no doubt see these things as the work of a Great Landscape Painter. The poet hears rhythm in the ripple of the brook, the musician the music of the breeze. Each, according to his vocational training and his inherent nature, endows what he sees with ideas associated with his particular activities. It is probable that the gardener or tiller of the soil imagines his god as a Great Agriculturist. The physician, in daily contact with the miseries and agonies of the world, might well look upon God as the Divine Torturer who strangles babies with diphtheria germs or who breaks their backs with the bacillus of infantile paralysis.

Indeed, once we place a thinking being behind the phenomena of the universe there is no end to the attributes with which he can be endowed. God can be looked upon as anything from a Dispenser of Sunshine to a Dispenser of Cholera Germs; from a Maker of Stars to a Manufacturer of Tapeworms and Lice.

Happily, no one but the theologians and the ignoramuses take the religious ramblings of scientists seriously; and Jeans' departure into the world of ghosts would not be mentioned here except as a typical instance of such departures.

Sir James is too well informed and far too able a reasoner not himself to distinguish between his own scientific knowledge and his religious fancies, and so he has prefixed his remarks with a qualifying admission: "I would say, as a speculation, not as a scientific fact, that the universe and all the material objects in it—atoms, stars, and nebulae—are merely creations of thought—of course not of your individual mind, but of some great universal mind underlying and coordinating all our minds." How admirably this "universal mind" is "coordinating all our minds" may be seen in the diverse opinions held by Sir James and Dr. Millikan, each of whom holds an opposite view as to the ultimate end of the universe, To Millikan, God is "still on the job" building up; to Jeans he is tearing down; to the atheist "he" is doing neither one thing nor the other, since no god exists. The coordination of our thoughts by a Supreme Thought is metaphysical twaddle.

Were there really a Cosmic Mathematician at work behind the universe, we might reasonably expect results in keeping with mathematical precision, and a Vacuum Calculator in the skies whose ultimate aim is the "heat-death" of the universe—an extinction taught by Sir James—might well have spared himself the trouble of getting busy at all, or of engaging in abstruse mathematical formulae in order to get nowhere. A mathematician who worked toward such empty endings as the smash-up of his work would be a fit subject for a padded cell.

The "heat-death" of the universe predicted by Jeans consists of the annihilation of every star through radiation, until there will be nothing left but an ocean of energy at its lowest ebb. It is an "end" hardly in keeping with his belief in a presiding mind. Literally, it is the smash-up of things without the semblance of a "come-back". "Many, giving rein to their fancy", writes Jeans,⁸ "have speculated that this low-level heat energy may in due course reform itself into new electrons and protons. As the existing universe dissolves away into radiation, their imagination sees new heavens and a new earth coming into being out of the ashes of the old. But science can give no support to such fancies." In a word, the plan behind the universe believed in by Jeans is the destruction of the universe! And the plan was devised, adopted and put into motion by a Supreme Mathematician some 10,000,000 million or more years before the

8. *The Universe Around Us*, p. 322.

stars emerged from nebulae! Such is the fantastic nonsense taught by those who muddle their science.

To think as Jeans does, is to imagine a super-mathematical genius—a sort of Celestial Jeans—sitting up nights, calculating how billions of stellar bodies should be moved, in order that, a few billion years later, one of their number might closely approach the sun and thereby produce the earth; and how that particular globe should be slowly condensed, in order that on May 23rd, 1999, at six o'clock in the morning (Daylight Saving Time), a particular bird should be at a particular spot in order to pick up a particular worm for breakfast. Were the universe operated by a Supreme Mathematician, as Jeans thinks it is, we should have to believe that every event and detail of our lives entered the calculation — which means that God knew every outcome from the “beginning.” We should have to believe that God knew a cancer would grow here,⁹ and a world war would occur there;¹⁰ that a mass of rotating gas would

9. The “Mathematician” who, billions of years ago, “figured out” so accurately where cancers should grow cannot be admired for his amiability. “We do not condemn our worst criminals,” remarks Prof. J. B. S. Haldane, “to anything as bad as an inoperable cancer involving a nerve trunk.” (“God-Makers,” *The Rationalist Annual*, 1931)

10. In his *Mr. Britling Sees It Through*, H. G. Wells makes his leading character exclaim: “Why! If I thought there was an omnipotent God who looked down on battles and deaths and all the waste and horror of this war—able to prevent these things—doing them to amuse himself—I would spit in his empty face.”

eventually evolve influenza germs and the priests of the Spanish Inquisition. In a word, the vast mistakes, follies, blunders and brutalities of existence all arose from mathematical formulae and well-planned "design". "I see," remarks the distinguished mathematician, Bertrand Russell,¹¹ "no comfort to be derived from the supposition that this very unpleasant universe was manufactured of set purpose."

VAIN IMAGININGS OF THE THEOLOGIAN

WERE we to take seriously the loose-end thinking of some of our scientific benefactors, we should be obliged to become Quakers because Eddington is, or Sandemanians because Faraday was, or perhaps even Catholics like Pasteur or Mendel. Or we might even write pious rubbish about the Book of Revelation because Newton did, or swallow mediumistic gibberish after the manner of Lodge and Lombroso. What really counts is not the religious drivel which men of science write, but their solid demonstrations, and Jeans' Cosmic Mathematician is as much a myth as the bewhiskered god of the Jews.

Thinking no more existed before the stars than did breathing or walking, or digesting one's dinner. "If we say, as was said long ago, 'In the beginning was Mind,' we may be expressing or trying to express a great truth, but we have gone beyond science."¹²

11. *The Scientific Outlook*, p. 118.

12. *The Outline of Science*, p. 57.

Not only have we "gone beyond science," but we have slunk back into the realm of nursery-tale nonsense, where cows jump over moons and dishes run away with spoons. So far as astronomy is concerned, the primeval chaos from which stars were born may have been created by anything at all, from Jehovah himself to Simple Simon or Puss in Boots—there is no limit to the stretch of one's imagination—but sober reflection leads us to conclude that the primeval mist existed on its own account and gave birth to the stars by inherent properties of its own. All attempts to read a mind into nature, to see in stellar activities the work of an invisible being, have hopelessly failed, and the real naturalist of the heavens looks to no other causes than those resident in matter itself. As Dr. Harlow Shapley observes,¹³ "The rise and decay of massive stars, the birth of planets, the organization of stellar systems" exclude anything "more supernatural than obedience to the laws of gravitational astronomy and physical chemistry."

The "crude imagery," as Jeans calls it,¹⁴ which pictures "the finger of God agitating the ether" may be set aside "by insisting on space, time and matter being treated together and inseparably as a single system, so that it becomes meaningless to speak of space and time as existing at all before matter existed." Matter, therefore, is co-existent and co-eternal with space and time, and from it all things arise. This is

13. *Harper's*, May, 1923.

14. *The Universe Around Us*, p. 328.

materialism, and beside it all metaphysical utterances are fit only for the waste-basket.

"So far as science is concerned," wrote the distinguished astronomer, Richard A. Proctor,¹⁵ "the idea of a personal God is inconceivable." The idea of a personal god is conceivable, but wholly unbelievable. Personal or impersonal, God is a delusion. It is a delusion because the very concept of the universe being guided by intelligence is obviously and provably false. From every domain of science there is a wealth of evidence which shows the blind urge and senseless activities of natural phenomena.

The whole rank absurdity of theism finds its most ludicrous aspects in its rejuvenated form, where God is represented as a sort of brainless personality hovering over the elements and telling them what to do. An "intelligence" thus running around loose in the universe, without body or brain and directing the course of the stars, is quite as ridiculous as the anthropomorphic concept of the deity as a Jewish patriarch with a long beard, who commands stars to come into existence by the power of his will. As a "spirit," God is a ghost—and ghosts exist for science only in the distorted brain cells of mentally feeble persons. As a "refined" abstraction of metaphysics, it may be classed with the smile of the Cheshire Cat which Alice of Wonderland saw, and which obligingly remained after the cat was gone. In a word, neither in astronomy nor in any other branch of science is

15. *Our Place Among Infinities.*

there need to postulate a cosmic "mind" behind or within phenomena. Stars are not fashioned by a ghost any more than waves are made by Father Neptune or babies are brought by storks.

The heavens no more proclaim the "glory of God" than they proclaim the glory of Mumbo Jumbo or the Sultan of Sulu. What they do proclaim is a ceaseless round of time-consuming movements which ends in the annihilation of stars. Eddington himself, Quaker reared and pious though he is, repudiates, with some trepidation, the silly attitude of the Psalmist's creed. "Probably most astronomers," says he,¹⁶ "if they were to speak frankly, would confess to some chafing when they are reminded of the psalm 'The heavens proclaim the glory of God.'" But not all astronomers "speak frankly" in dealing with religion.

There is something really pathetic in the statement that the universe was made for man. There is something even more pathetic in the belief that it was made for the "glory of God."

The small-dimensional world hatched by superstition gives way before astronomy: the further we peer into space, the smaller does our earth become, and the more we are removed from anything resembling heavenly solicitude. Stellar activities are neither moral nor immoral: they do not think, do not know what they are about. Everywhere there is the blind sequence of physical activity. The sun no more ex-

16. Swarthmore Lecture, 1929. *Science and the Unseen World*, p. 17.

ists to warm us than it does to scorch the Arizona desert or stunt life in equatorial Africa; stars are not "made" in order that mariners may find their way at sea; they exist on their own account, and have existed for billions of years before the earth emerged from the sun; the moon is no more interested in the happy crooning of sweethearts than the floods and devastating tidal waves it causes on earth. Everywhere in the heavens are non-planned forces at work, behind which there is no celestial being, no God.

There is no eternal Justice in the heaven, no helping hand. The stellar depths are silent as the grave to human misery and want. The vast abyss of space is both our womb and our tomb. It cares neither for our coming nor our going, our arrival or dismissal.¹⁷

17. "A single hurricane," says John Stuart Mill, "destroys the hopes of a season; a flight of locusts, or an inundation, desolates a district; a trifling chemical change in an edible root starves a million of people. The waves of the sea, like banditti, seize and appropriate the wealth of the rich and the little all of the poor with the same accompaniments of stripping, wounding, and killing as their human antetypes. Everything, in short, which the worst men commit either against life or property is perpetrated on a larger scale by natural agents. Nature has *noyades* more fatal than those of Carrier; her explosions of firedamp are as destructive as human artillery; her plague and cholera far surpass the poison-cups of the Borgias." (*The Idea of God in Nature*) "If, indeed, there were a judgment-day," writes Winwood Reade, in his excellent work, *The Martyrdom of Man*, p. 518, "it would be for man to appear at the bar, not as a criminal, but as an accuser." Man has never been an object of cosmic care. He must do things for himself.

Only the ceaseless drive of nonthinking forces could be responsible for such aimless and senseless gyrations as the stars exhibit over protracted periods of time. No mentality above the level of an idiot would devise such madhouse "schemes" as that of spinning billions of globes for amusement or of tossing them around aimlessly to prove itself intelligent. The debacle of the heavens cannot be traced to design.

From the welter of lifeless globes our own little world emerged through the chance encounter of two stars. It came into existence as an exceptional occurrence in the life of the stars. "Among so many myriads of stars," writes Eddington,¹⁸ "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 traveling for the whole of its 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 play 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." There is no guidance here, no conscious cause at work among the stars.

18. Swarthmore Lecture, 1929, *Science and the Unseen World*, p. 11.

CHAPTER VI

THE FINAL IMPLICATIONS

Theism is doomed . . . in all ages the advance of civilization to its heights has brought about an increasing disbelief in all religion. Now that, for the first time in history, we are universalizing culture, the prospect is clear. No refinement of the idea of God can save it from disappearance.—JOSEPH McCABE.¹

If indeed the world in which we live has been produced in accordance with a Plan, we shall have to reckon Nero a saint in comparison with the Author of that Plan. Fortunately, however, the evidence of Divine Purpose is non-existent; so at least one must infer from the fact that no evidence is adduced by those who believe in it. We are, therefore, spared the necessity for that attitude of impotent hatred which every brave and humane man would otherwise be called upon to adopt toward the Almighty Tyrant.—BERTRAND LORD RUSSELL.²

If you are in the habit of believing in special providences, or of expecting to continue your romantic adventures in a second life, materialism will dash your hopes most unpleasantly, and you may think for a year or two that you have nothing to live for. But a thorough materialist, one born to the faith and not half plunged into it by an unexpected christening in cold water, will be like the superb Democritus, a laughing philosopher.—GEORGE SANTAYANA.³

Convinced that there is no eternal life awaiting him, he [man] will strive all the more to brighten his life on earth and rationally improve his condition in harmony with that of his fellows.—ERNST HAECKEL.⁴

1. *The Future of Religion*, p. 60.

2. *The Scientific Outlook*, p. 130.

3. *Reason in Science*, pp. 89-90.

4. *The Wonders of Life*, p. 108.

The belief in God may continue awhile in virtue of the lack of intelligence of some, of the carelessness of others, and of the conservative character of the mass. But no amount of apologising can make up for the absence of genuine knowledge, nor can the flow of the finest eloquence do aught but clothe in regal raiment the body of a corpse.—CHAPMAN COHEN.⁵

BRIEFLY summarized, the salient points of cosmic evolution from nebulae to man are as follows: There are, on Eddington's calculation, more than 300,000 million stars inside the sun's orbit alone. These stars, weighed en masse, have a weight equal to about 270,000 million suns the size of our own. This is the raw material, the amazing cosmic "batter", from which our planetary system came. The relation between the amount of material used and the puny result obtained is ludicrous in the extreme. It is like mixing a batter of dough as big as the sun to bake a single crumb of bread. A baker who worked on the basis of that much material as a means to an end would be considered a dolt.

The time period consumed is equally deadly to the assumption of an intelligent process. Stars, according to Jeans,⁶ have existed for from five million million to ten million million years, and the atoms that compose them "may have previously existed in nebulae for at least a comparable, and possibly for a much longer, time." This means roughly that the universe, in its transitional period from nebulae to man, has

5. *Theism or Atheism?* p. 128.

6. *The Universe Around Us*, p. 326.

consumed approximately between ten million million and twenty million million years. This is the time it has taken the "Infinite Intelligence" of the universe to reach the "desired" end. And the end? It can be found in any good work on evolution depicting the long, cruelly-drawn-out, ghastly struggle of life, from amoeba to man.⁷

The process of planetary birth is exceedingly round-about, and depends upon the most fortuitous circum-

7. Man's descent from a primitive anthropoid ape, resembling the chimpanzee of today, is no longer a matter of dispute among leading anthropologists. "All the evidence now at our disposal," said Sir Arthur Keith, in his presidential address to the British Association, Leeds, 1927, "supports the conclusion that man has arisen, as Lamarck and Darwin suspected, from an anthropoid ape not higher in the zoological scale than a chimpanzee." Our pre-ape ancestry necessarily extends back to creatures even lower in the scale of life than the long-tailed, tree-living monkeys from which we are also descended. "60,000,000 years ago," writes J. B. S. Haldane, "our ancestors were mammals, probably not unlike lemurs; 300,000,000 years ago amphibians, somewhat resembling newts or mud-puppies; and 500,000,000 years ago very primitive fish, combining some of the characters of sharks and lampreys." ("Some Dates," *The Rationalist Annual*, 1928) And Darwin himself writes, *Descent of Man*, p. 183: "At a still earlier period the progenitors of man must have been aquatic in their habits. . . . In the lunar or weekly recurrent periods of some of our functions we apparently still retain traces of our primordial birthplace, a shore washed by the tides. . . . These early ancestors of man, thus seen in the dim recesses of time, must have been as simply, or even still more simply, organized than the lancelet or amphioxus." Man's earlier ancestors were worms, which themselves arose from still lower forms. The "Adam" of the race was a microscopic speck.

stances. A nebula must first of all rotate for aeons before it condenses into stars. Now stars are intensely hot, gaseous bodies, and cannot bear life at any stage of their existence; planets alone cool to a point where life becomes possible. But planets, by a bad stroke of cosmic "wisdom," are exceedingly scarce. A star before it can give birth to a planet must approach another star close enough to raise "tides" on its own surface. The chance of any star doing this is infinitely small, considering the vast distances which separate the stars. It is a case of blind man's buff, in which a fortuitous meeting of stars is like the drawing of a single prize from countless blanks. When, by the merest chance, two stars do approach to within about three diameters' distance of each other, a group of planets is born. "The calculation shows," says Jeans,⁸ "that even after a star has lived its life of millions of millions of years, the chance is still about a hundred thousand to one against its being a sun surrounded by planets." Now if life is important to the universe, planets ought to be more numerous than the stars, and their process of origin should depend upon something more indicative of intelligence than a fortuitous meeting of stars. A "hundred thousand to one" chance of anything occurring is not reflective of "plan" or "design". The result is precisely what might be expected in a blind and groping series of events. Even when a planet is born it is not assured of life; and of the nine planets

8. *The Universe Around Us*, p. 332.

of our system only one is an inhabited world. It is a dismal picture of stellar "wisdom".

And even after a planet is born, it must, in order to be a suitable abode for life, be neither too hot nor too cold, too near nor too far away from its sun. If it is either of these it will remain among the number of lifeless globes. Out of 300,000 million stars only a handful of planets has been born, and of this handful only one is known to possess life. The result is even less than what might be expected under the laws of chance or in the spinning of a roulette wheel.

Six specks of dust floating about Waterloo Station make up, in bulk, the relative equivalent of the tiny substance which comprises the stellar universe. Turn off, at midnight, the lights in Waterloo Station and you have a fair idea of the blackness and dreariness of interstellar space. Next, turn off the heat in the great railway terminal, and allow the temperature to fall to the frigidity of interstellar space, and you will have an entrancing picture of the "glory" of the heavens at 469° below zero! "A thermometer," writes Jeans,⁹ "placed out in interstellar space, far from any star, would probably show a temperature of only about four degrees above absolute zero, while still lower temperatures must be reached out beyond the limits of the galactic system." Absolute zero, we must remember, is not to be confused with that of either the Centigrade or Fahrenheit scales, but is sufficient, as the same writer reminds us, to freeze "air, hydrogen

9. *The Universe Around Us*, p. 99.

and even helium, the most refractory gas of all, solid."

And what must we think of this alleged intelligence in the skies, which, after toiling for billions of years, produces nothing more imposing than the equivalent of six specks of dust in a great railroad terminal? If there is "glory" in this, there is glory in producing that which is next to nothing. "The extreme emptiness of astronomical space," as Jeans calls it,¹⁰ really constitutes the chief item of celestial observation. Our "star-filled" universe is a poverty-stricken affair.

In sum, the picture of the universe presented by astronomy is one of dismal stretches of time and space and unparalleled desolation. In the eternal abyss of space—bleak, cold, and dark — are no signs of a Cosmic Consciousness.

Such is the message which astronomy brings: a message which is more reassuring to man in his more contemplative moods, since it proves that not even planets and world constellations can forever endure. His extinction at the hands of the blind agencies responsible for his existence will be followed in due time by the extinction of every star. "With universes as with mortals," says Jeans,¹¹ "the only possible life is progress to the grave."

Out of star-dust man came, and into it he will sink again, as oblivious of his own passing existence as he was before that existence painfully and slowly evolved

10. *The Universe Around Us*, p. 106.

11. *The Universe Around Us*, p. 321.

and separated him, for one brief instant, from the blindly-groping Whole. Into the eternal chasm of cosmic destruction all things flow. Matter, time and space are the sole permanents of existence: the rest perish. What then are kingdoms and scepters, miters and tiaras, honors and dishonors, in the solitudes of space! With princes and beggars, loves and hatreds, laughter and tears, ignorance and knowledge, they are doomed to destruction in the eternal maelstrom of space as the mightiest of suns!

Across the sky is written in blazing stars: waste, extravagance, futility! Little wonder that, peering through his telescope, the great astronomer Lalande¹² could say: "I have searched through the heavens, and nowhere have I found a trace of God."

12. Buchner's *Force and Matter*, p. 105.

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There was a time, known as the Golden Age of Freethought, from about 1865 to 1925, when it was thought that the Higher Religions -- Rationalism, Secularism, Deism, Atheism and other “thinking” religions (as opposed to the lower “believing” religions) would be the main religious force in Western Civilization within 50 years. The failure of this great upward religious movement was no fault of the new and elevating religious ideas; these new progressive religious ideals were forcefully suppressed by the political power of the old beliefs.

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