Classic Reprints

Editor's Introduction: *In this issue we bring you another classic article from early issues of the* Creation Research Society Quarterly. *This one from one of our founding members appeared in the first issue, the 1964 Annual on pages 18–23.*

The Power of Energy

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This title may at first disturb the disciplined scientific mind because of its apparent dimensional inconsistency. As a matter of fact, for our present purposes, it might just as well be titled "The Energy of Power." The point to be made, in either case, is that *energy*, as a concept, is tremendously powerful, both in the solution of technical problems and in its implications with reference to the true understanding of nature and the universe. And this is true whether we are speaking technically of energy or its time-derivative, power. Neither is an actual physical substance, of course, but each is an extremely useful and significant concept, without which the great contributions of modern science could hardly have been possible. Dr. R. B. Lindsay, director of the ultrasonics laboratory at Brown University and dean of its graduate school, says:

> Of all unifying concepts in the whole field of physical science, that of energy has proved to be the most significant and useful. Not only has it played a major role in the logical development of the structure of science, but, by common consent, it is the physical concept which has had and still has the widest influence on human life in all its aspects. Under the prevailing misnomer 'power,' it is the stock-in-trade of the engineer and that which makes the wheels of the world go round. … the interpretation of phenomena in terms of the transfer of energy between natural systems is the most powerful single tool in the understanding of the external world. (Lindsay, 1957, p. 188)

The power of the energy concept is implicit in the two great laws of thermodynamics, which are without question the two most basic and securely founded of all the laws of physical science. All real processes in the physical or biologic realms necessarily involve transformations of energy from one form into another. The first law of thermodynamics, that of energy conservation, expresses the quantitative equivalence of total energy before and after the transformations. The second law, that of energy deterioration, states that in the process some of the energy must be transformed into non-recoverable heat energy—not destroyed but rendered unavailable for use. In terms of "entropy," which is merely a measure of the non-availability of the energy of a system, any natural process or transformation of energy in a closed

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mechanical system necessarily involves an increase in the entropy of the system. According to the great Harvard physicist P. W. Bridgman,

> The two laws of thermodynamics are, I suppose, accepted by physicists as perhaps the most secure generalizations from experience that we have. The physicist does not hesitate to apply the two laws to any concrete physical situation in the confidence that nature will not let him down. (Bridgman, 1953, p. 549)

The universal validity of the first law, that of energy conservation, is also indicated by Gerald Feinberg and Maurice Goldhaber. Feinberg is associate professor of physics at Columbia University, and Goldhaber is director of the Brookhaven National Laboratory. They write:

> The physicist's confidence in the conservation principles rests on long and thoroughgoing experience. The conservation of energy, of momentum, and of electric charge have been found to hold, within the limits of accuracy of measurement, in every case that has been studied. An elaborate structure of physical theory has been built on these fundamental concepts, and its predictions have been confirmed without fail. (Feinberg and Goldhaber, 1963, p. 36)

With respect to the second law, the following evaluation by A. R. Ubbelohde, professor of thermodynamics at the Imperial College of Science and Technology of the University of London, is typical:

> In its most modern forms, the Second Law is considered to have an extremely wide range of validity. It is a remarkable illustration of the ranging power of the human intellect that a principle first detected in connection with the clumsy puffing of a steam engine should be found to apply to the whole world, and possibly even to the whole cosmic universe. (Ubbelohde, 1955, p. 146)

It would be difficult to point to any of our basic methods or formulas in any branch of mechanics or engineering which are not intimately related to these energy requirements. Though the working scientist or engineer may be inclined to overlook them, being engrossed in a tangle of technical details and specific procedures, he will find that both his techniques and basic insights will be greatly strengthened if he maintains a continual awareness of the fundamental energy relationships to which his designs and decisions must conform.

It is not too surprising, then, to find that these relationships and the very concept of energy itself lead to tremendous inferences far beyond the realm of mechanics and thermodynamics to which they were first applied. The basic nature of "energy" or "power" is still enveloped in mystery. Energy can appear in many quantitatively interchangeable forms—electrical energy, chemical energy, sound, heat, light, pressure, magnetic energy, mechanical energy, etc. And one of man's greatest scientific discoveries has been that of the identification of matter itself as merely one form of energy, so that the law of mass conservation becomes only a special case of the law of energy conservation, and matter becomes under the proper conditions interconvertible with other energy forms.

Since all the physical universe, including matter, is ultimately energy, and since energy can be neither created nor destroyed, according to the conservation principle, the inference is that the totality of energy in the universe has never changed since its origination. Either the universe has always existed in its present state (and this is contradicted by the second law of thermodynamics), or it was at some time in the past brought into its present state, necessarily by means of laws or principles not now operative in the universe. Once these latter laws were superseded by the present conservation-deterioration laws, there could have been no additional creation or destruction of the physical stuff of the universe.

This fact is not obvious from a superficial examination of nature, which exhibits numerous cases of *apparent* causeless origins and *apparent* increases of order, reflected in the many crude notions of spontaneous generation and evolution held by ancient philosophers. The conservation law has only been accepted within the past 120 years, after much scientific labor and against much opposition. It is remarkable, therefore, that in the first chapter of Genesis, following the familiar biblical account of Creation, appears the following:

> Thus the heavens and the earth *were finished*, and all the host of them. And on the seventh day God *ended his work which he had made*; and he *rested* on the seventh day *from all his work which he had made*. (Genesis 2:1–2).[1]

With reference to the energy balance of the earth, which of course depends almost wholly upon the influx of solar radiant energy, the further significant statement is made that the function of the sun, relative to the earth, was "to give light upon the earth" (Genesis 1:17).

Whether or not the writer understood the significance of this assertion, the fact remains that the sun's "light," or radiant energy, provides all the earth's usable energy except that of its own rotation and the nuclear energy of its atomic structure. The sun's light maintains the physical and biologic life of the earth. It has been calculated that all the stored-up energy sources of the earth—its coal, oil and gas reserves, its peat and timber, even its fissionable uranium—would only suffice to keep the earth going for

[1] All Scripture quotations are from the King James Version of the Bible.

about three days if the sun's energy were to be cut off (Ayres and Scarlott, p. 186)!

The energy of light, in fact, may be considered as the most basic of all the forms of energy. It includes all radiant energy, from the X-rays and cosmic rays and other short-wave-length radiation at one extreme, through visible light, heat, and the electromagnetic rays at the opposite end of the spectrum. The energy of matter is basically light energy, with matter and energy related by the Einstein equation through the fundamental and universal constant of the velocity of light. The first creative command of God, according to the Genesis record, is thus very significantly said to have been: "Let there be light: and there was light" (Genesis 1:3).

The energy conservation law is occasionally said not to have proved universally successful when applied to phenomena on the subatomic scale. Quite possibly this is because of the still very incompletely understood nature of these phenomena, and in fact the somewhat still mysterious relation between matter and energy. Of course, this area of investigation is so complex and specialized and so rapidly changing that no one but a very up-to-date nuclear physicist should hazard any definite statement about the basic significance of nuclear phenomena.

However, within the accuracy of all pertinent experimental evidence, it is true that the energy conservation principle has been demonstrated true on the subnuclear scale no less than on the scale of ordinary experience. As Feinberg and Goldhaber (1963, pp. 39, 42) have recently pointed out:

> Thousands of laboratory experiments, performed in different ways and measuring all the quantities involved, have confirmed that the laws of conservation of energy and momentum do hold true in the domain of elementary particles. … It is clear that the laws of conservation of energy and momentum, introduced … to describe collisions between macroscopic bodies, also apply with remarkable accuracy to the collisions and interactions of sub-atomic particles.

One thing is certain, and that is that the energies associated with the various nuclear particles are tremendous and, when partially converted into other forms of energy through nuclear fission or thermonuclear fusion processes, the physical effects can be cataclysmic. The source and nature of the binding energy that normally maintain the integrity of the atomic structure against the powerful electrical forces tending to disintegrate it are yet quite uncertain, although many of its characteristics have been determined.

Physicist R. E. Peierls, professor of mathematical physics at the University of Birmingham in England, and past president of the Atomic Scientists Association, says:

> The next fundamental problem that arises is that of the nature of the forces which hold the neutrons and protons in a nucleus together … the attractive energy that holds any one particle in the nucleus is, in general, of the order of 6 to 8 million volts … to obtain the precise laws of the nuclear forces is one of the central problems of nuclear physics, which is not, as yet, completely solved. (Peierls, 1956, p. 240)

And the problem today seems as far from solution as ever. As modern research has thrown more and more light on the nature of the nucleus, with its 20 various subnuclear particles, the more complex does its nature seem to be. Even if its physical character is eventually completely understood, its basic origin and source would still be at best a matter of pure speculation. Peierls admits:

> Even if one day we find our knowledge of the basic laws concerning inanimate nature to be complete, this would not mean that we had 'explained' all of inanimate nature. All we should have done is to show that all the complex phenomena of our experience are derived from some simple basic laws. But how to explain the laws themselves? (Peierls, 1956, p. 275)

Another quite remarkable assertion of the Scriptures is pertinent here. The writer of the epistle to the Hebrews mentions that, having first made the worlds, God (through His Son) now is continually "upholding all things by the word of his power" (Hebrews 1:3). A legitimate paraphrase of the Greek original here would be that He is "maintaining the physical integrity of the matter of the universe by means of the continual efficacious outflow and outworking of His innate infinite reservoir of basic energy."

The same intimation of the maintenance of the integrity of matter by a certain basic and primal form of energy (and therefore of the essential equivalence of matter and energy) is suggested also by St. Paul, when he says, "By him [i.e., Christ] all things consist [hold together]" (Colossians 1:17), and by St. Peter, who says, "The heavens and the earth which are now, by the same word are kept in store" (2 Peter 3:7).

But the full import of the energy concept cannot be grasped until we consider also the second law of thermodynamics. In any closed system, in which energy transactions take place, the availability of the energy for the performance of useful work must always decrease. The total energy remains unchanged, but its usefulness has decreased.

This physical phenomenon is not at all obvious on the surface of things and had to overcome much opposition before it became generally accepted as scientific truth. It seemed to contradict the philosophy of progress and developmental evolution. Nevertheless, the brilliant theoretical and experimental researches of Carnot, Clausius, and

Lord Kelvin, followed by numerous others in more recent decades, have definitely proved this second law to be of essentially equal validity with the first. In recent times, it has even been possible to analyze and predict in some cases actual rates of energy dissipation (or entropy increase). This sort of study, of course, becomes of great practical importance in engineering design and analysis. Energy dissipation is often of paramount importance in the mechanics of the conversion process and its efficiency, and therefore in its cost of operation. The second law of thermodynamics precludes the design of any process or machine 100% efficient, as well as any sort of perpetual motion device.

Because of the historical background, it has been customary to think of these two laws of thermodynamics as more or less interdependent. However, there does not seem to be any necessary connection between them. The fact that the totality of energy remains constant does not in itself imply at all that its availability should continually decrease. In fact, there now exists a considerable body of evidence that this so-called second law of thermodynamics is only a particular application of a much more general law which deals not only with the phenomena of physical energy but also with many other categories of phenomena in the physical, biological, and perhaps even in the psychological and sociological realms. This broader law has been called by the British physicist Dr. R. E. D. Clarke (1948, p. 150) the "law of morpholysis," a term derived from two Greek words, and meaning simply "loosing of structure."

This term seems admirably adapted to describe a very important and apparently universal phenomenon, namely that there always exists a tendency in nature towards disorder or disorganization. The law of morpholysis merely formalizes the everyday observation that any evidence of order or organization requires some sort of explanation to account for it, whereas anything exhibiting randomness or disorder or 'heterogeneity' is *per se* "natural" and does not call for any explanation as to how it was thus arranged. The natural tendency is always from the state of maximum improbability to that of maximum probability, from the organized to the disorganized. Any sort of ordered arrangement requires some sort of external agency to bring it about. Harold F. Blum, professor of biology at Princeton, says:

> All real processes go with an increase in entropy. The entropy also measures the randomness or lack of orderliness of the system, the greater the randomness the greater the entropy; the idea of a continual tendency toward greater randomness provides the most fundamental way of viewing the second law. (Blum, 1962, p. 15)

Even from an engineering viewpoint, this is now recognized as the real significance of the second law of thermodynamics. This concept of entropy explains energy deterioration in terms of decreased order of molecular or atomic structure. In discussing the entropy concept and some of its newer application, Dr. W. L. Everitt, dean of engineering at the University of Illinois and past president of the American Society for Engineering Education, points out:

> It may be inferred that entropy is a measure of randomness, confusion, or lack of organization. Such a term can be applied not only in a thermodynamic sense, but also to information problems. (Everitt, 1957, p. 658)

This tendency toward disorder is, of course, apparent in many realms beside that of energy dissipation. There is the phenomenon of aging and death in living creatures, for example, still very incompletely understood but apparently related to the breakdown of complex and unstable protein molecules into simpler and more stable ones, less able to transmit free energy for biologic processes.

Similarly, the primary mechanism of biologic evolution of species, that of mutation of genes in the germ cells, operates when some disorganizing medium such as short-wave-length radiation, certain powerful chemicals, etc., penetrate the germ cell and disturb its previously highly organized chemical structure. The reshuffling of genetic factors thus induced would nearly always decrease its degree of order and organization and therefore result in a less viable and efficient organism. This is why almost all, perhaps all, mutations are either lethal or harmful to the creatures experiencing them in their struggle for existence. This is supported by no less an authority than Dr. H. J. Muller, perhaps the world's outstanding living geneticist and authority on mutational mechanics:

> It is entirely in line with the accidental nature of natural mutations that extensive tests have agreed in showing the vast majority of them to be detrimental to the organism in its job of surviving and reproducing, just as changes accidentally introduced into any artificial mechanism are predominantly harmful to its useful operation. According to the conception of evolution based on the studies of modern genetics, the whole organism has its basis in its genes. Of these there are thousands of different kinds, interacting with great nicety in the production and maintenance of the complicated mechanism of the given type of organism. Accordingly, by the mutation of one of these genes or another, any component structure or function, and in many cases combinations of these components, may become diversely altered. Yet in all except very rare cases the change will be disadvantageous, involving an impairment of function. (Muller, 1955)

It is probable that such mutational deteriorations account for many phenomena of paleontology and morphology, such as vestigial organs and the fact that most modern creatures are repre-

sented in the fossil record by larger and more highly developed individuals than their modern counterparts. Mutation, isolation, inbreeding, etc., also may account for the historical deterioration of once virile sociological units of peoples and cultures, encountered so frequently in the study of history.

But it is the cosmological implication of morpholysis that is of greater significance. If the entropy or disorder of any closed system must continually increase, and since the universe may be regarded as a very large, but finite, closed system, it follows that the universe as a whole is becoming progressively more disordered. Its reservoir of physical energy is continually degrading, tending ultimately to a state where all energy will have deteriorated to unavailable heat energy. The universe, in other words, is "running down"; it is growing old, wearing out.

It cannot, therefore, be infinitely old; if it were, it would already have attained this state of maximum entropy. It must have had a beginning. If it is growing old, it must once have been young; if it is wearing out, it must have once been new. A universe now running down must first have been "wound up."

This is the inexorable conclusion of the second law, unless one is disposed to assert a continual evolution of fresh matter or energy out of nothing somewhere in space (according to the theory of Fred Hoyle and others) or to insist that the universe is pulsating, with the entropy periodically reversed to permit its rewinding. Neither of these alternatives, of course, is supported by a shred of *direct physical evidence*, but only by assumptions as to what, in the judgment of their proponents, the nature of things *ought* to be. See, for example, the cogent criticism of theories of this kind by Herbert Dingle, professor of the history and philosophy of sciences at the University of London (Dingle, 1956, pp. 224–236). On the other hand, there is literally a tremendous mass of direct physical evidence supporting the entropy law.

However, these alternate hypotheses do point up one fact, namely that the morpholysis principle is not inherent in the basic nature of things. The very fact that men of intellect can conceive and support alternative theories proves this. This tendency toward disorder seems somehow, intuitively, to be an unwelcome intruder into the ideal nature of things, something that *ought not to be* but which nevertheless *is*. Just *why* this deteriorative principle is an apparently universal law is seemingly beyond the reach of scientific discovery.

But here it is possible that the Scriptures, already seen to contain remarkable intimations about the fundamental nature of things, may again have something significant to say. The basically spiritual nature of energy has already been inferred, so that the principle of deterioration of energy may likewise involve spiritual overtones.

Thus, the Christian doctrine of the Fall of man and the resultant curse of God on His creation, as taught in Genesis (Genesis 3:17–19; see also Romans 5:12; 1 Corinthians 15:21–22), although often rejected as mythological by modern intellectuals, is able to provide at least a causal explanation for the universal phenomenon of morpholysis. At the same time, it refutes the hopelessly pessimistic future of the universe implied by the second law of thermodynamics by reminding us that He who established the creation and who later imposed upon it the curse of corruptibility and decay is yet Himself outside the creation and therefore not subject to its laws. For example, quoting again the author of Hebrews, who in turn is quoting Psalm 102:

> And, Thou, Lord, in the beginning hast laid the foundation of the earth; and the heavens are the works of thine hands: they shall perish; but thou remainest; and they all shall wax old as doth a garment; and as a vesture shalt thou fold them up, and they shall be changed: but thou art the same, and thy years shall not fail. (Hebrews 1:10–12; see also 1 Peter 1:24–25; Matthew 24:35; Isaiah 51:6; etc.)

A future time when the curse shall be removed from the earth, and when, therefore, the law of morpholysis will presumably be "repealed," is often promised in Scripture. In the classic eighth chapter of Romans, said by Martin Luther to be the greatest chapter in the Bible, St. Paul says:

> For the creature was made subject to vanity, not willingly, but by reason of him who hath subjected the same in hope, because the creature itself also shall be delivered from the bondage of corruption [literally "decay"] into the glorious liberty of the children of God. For we know that the whole creation groaneth and travaileth in pain together until now. (Romans 8:20–22; see also Revelation 21:1, 4; 22:3; Isaiah 66:22; 2 Peter 3:13)

But for the present we must continue to live with the entropy principle. The engineer must continue to design his machine or process with full allowance for the effects of energy dissipation. Great strides are being made in the broader application of these concepts of energy conservation and deterioration in atomic energy, computers and automation, rocketry, inertial guidance, and even in such fields as information theory. A more incisive and inclusive understanding of the real character of the second law, especially, will undoubtedly result in still more remarkable technological advances, in probably every area of science.

But one cannot help but sense a danger, even perhaps a probability, that new scientific and technological breakthroughs may, as has often been true in the past, only accelerate the sociological and moral morpholysis. Energy and entropy are, we repeat, basically nonmaterial, even spiritual, in essence.

As to sources of strictly physical power, it appears that the so-called Christian West is rapidly being overwhelmed by the anti-Christian forces of the world. In manpower, it has long been obvious that the West is immensely inferior. In potential energy sources, considering the vast and largely untapped resources of Russia, Asia, and probably Africa, the reservoir of the East is again far larger than that of the West. Even in the nonmaterial resources of intellectual and moral power, there is no little evidence today that the Eastern peoples are at least the equals of those in the free world.

In a day and age in which the balance of power in a technological sense has been superimposed upon the old concept of the balance of power in a military sense as determinative of the world's future, we have suddenly come to realize that our Western delusion of perpetual superiority may be tragically unrealistic. Evidences are multiplying that the true balance of power in the world henceforth may favor those forces that are being arrayed in opposition to us.

But there does remain one largely unused source of power, access to which is more to be valued than all others combined. The One who inhabits eternity, who has created and who "upholds all things by the word of his power," is Himself the source of all physical, intellectual, moral, and spiritual energy. Access to this spiritual power (and often even to physical and intellectual strength) is obtained through prayer and a Christ-centered faith, according to the testimony both of biblical revelation and of millions of individual Christians across the centuries, including the writer of this paragraph. In the words of St. Paul, "For I am not ashamed of the gospel of Christ: for it is the *power* of God unto salvation to every one that believeth" (Romans 1:16).

Therefore, for instruction in the matter of power sources for those who deal in science and technology, for insight into the universal significance of the concepts of energy and power, for encouragement to all who are disturbed over world conditions, and for personal exhortation to those individuals who would seek for roots in eternity, we close with the words of Him who, after dying in atonement for the sins of fallen man and then after winning the ultimate triumph over the universal rule of decay and death by His bodily resurrection from the tomb, could say with all assurance:

> *All power* is given unto me in heaven and in earth. … and, lo, I am with you alway, even unto the end of the world. Amen." (Matthew 28:18, 20)

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