AN EXAMINATION OF ENERGY
Understanding God's Mighty Power in a Tangible Way

by Chard Berndt

"You are worthy, our Lord and God, to receive glory and honor and power, for you created all things, and by your will they were created and have their being." (Rev 4:11)

In churches, persons speak of God's power in a spiritual sense, such as the power of God to change lives, to administer judgment, or to influence kings. In science classes, one learns of power in a quantitative sense, employing the metric unit of measure known as the watt. Yet this physical power of God, such as that employed in the act of Creation, is often contemplated in vague terms, as is His spiritual power. This is because God's power is an abstract concept, and as the Bible tells us, immeasurable. Yet just because we can't measure the *whole* of His power, this does not mean we are unable to begin measuring what we *do* know of it.

In my study and instruction on the topic of energy, I have been impacted powerfully (spiritually speaking) by the reality of God's actual creative power (physically speaking). If you'll vow not to be intimidated by a few basic scientific ideas, I will attempt to show you just how powerful God really is.

To discuss power, I must first expand upon the concept of energy. Energy can be classified into five major types: Radiant, potential, kinetic, thermal, and nuclear.

Radiant energy is the purest form of energy—originating with the edict "let there be light" from the Creator itself. Scientists call it "electromagnetic radiation," or simply "light," although it encompasses much more than the slice of the electromagnetic spectrum that God designed our eyes to see, a.k.a. "visible light." I call it the "purest" form of energy because it does not depend upon any matter or motion, and is not measured relative to anything else; rather, it exists absolutely, moving effortlessly through empty space at the universe's speed limit. This sets it apart from our remaining four classes of energy, which are carried by matter and matter's motion.

Potential energy is energy *waiting* to produce motion, but which is not itself in motion (such energy is measured relatively, because "motion" is a comparative concept). If you were to wind up a manual clock, you would be coiling the spring inside, and giving it potential energy. While locked in place, this energy is not realized, but is in a state of energy potential, hence the term potential energy. If released, it will uncoil and produce motion, either gradually (to drive the gears of the clock), or suddenly (if the clock is defective).

Potential energy also exists in anything that has room to fall. A decoration on the mantel has potential energy (because you lifted it up to that point), and if it slips, the force of gravity acts

upon its mass, releasing its energy as motion. Thus, "to fall" could be defined scientifically as "to yield potential energy as a result of unhindered gravitational force." (When you see something fall, though, do not declare aloud what just happened scientifically, because you may sound as if you are flaunting your knowledge of thermodynamics.)

Years ago, I sat on a massive mountain ridge with some high school students trying to loosen small boulders, to watch them roll down furiously. Particularly for the young men present, this activity induced high adrenaline. (Obviously, this was not in the High Sierras, or we would have served jail time for threatening lives and infringing on the well being of rocks). The potential energy concept crossed my mind, and I was suddenly struck (as if with a boulder) that all we were doing was releasing energy that was given to the granite when those mountains were once thrust into place. The energy was visibly enormous, and yet these rocks, compared to the massive batholith that birthed them, were puny. Their energy did not just exist; it was given to them. Even if we explain it through geological processes, those very processes required energy. Ultimately, God gave those rocks a diminutive share in His massive energy storehouse when he first lifted them up. When we consider the mass of all rock elevated in that ridge system, plus the sum of all other ridge systems on earth, the sum of all other geological elevations on other planets, asteroids, and so on—we understand that there is a whole lot of potential energy still remaining.

But potential energy is only one part of the vast storehouses of mechanical energies. When potential energy is lost, **kinetic energy** is gained, and most of the time it is a reversible process. Such is the case in the mantel decoration, gaining speed as it falls to the floor, and the boulders, bouncing down the mountain slope. This kinetic energy is simply the energy of motion. Our whole world contains motion, natural and artificial, and because we depend so little on human power, we may forget just how powerful this motion is, and why it occurs. When a car collides with a tree or embankment, the massive force that crushes and shears is the result of the car's kinetic energy. To appreciate that energy, without having to survive a collision, put your car in neutral, get out, and try to accelerate it to sixty miles-per-hour!

But does God accelerate cars? In a sense, yes, because He made fuel possible by creating life, burying it in the Great Flood, and causing massive forces in the earth's crust to transform those elements into the petroleum that we tap and refine for our number one mode of transportation. Every time we drive, we are trading in potential (fuel) in order to get kinetic energy (speed). Even when we initiate human-powered movement, we also trade potential energy (from the food we consumed) for motion.

And yet, just as objects themselves have motion, so do the molecules that make up those objects. A glass of water at room temperature, or even a block of wood, has yet another type of energy, known as **thermal energy**. It could be thought of as "micro-kinetic" energy, as all molecules are either darting around (in a gas), moving around (in a liquid), or vibrating (in a solid). We usually think of it as "heat." If an object has

1) mass, and

2) a temperature above absolute zero (a chilly -459.67^{o} F),

then that object has heat. Yet nothing can ever reach absolute zero, so every thing has thermal energy. But just how much? One way to appreciate this is by taking out some of that energy, such as by putting the water into the freezer. While you wait, the freezer takes out about 53,000 Joules of heat to freeze twelve fluid ounces of water. That's not a great deal of heat (despite the large number), and yet it is only a little bit of water, and there are still about 200,000 Joules of energy left in the ice (yes, ice still contains heat). Now consider the oceans, housing most of the earth's water: they contain roughly 220 quadrillion gallons of water, which translates into about 6×10^{22} Joules of heat. Again, that energy didn't always exist. When God formed H_2O, he also put that much energy into it, just so it could be liquid water.

Thermal energy also plays the energy-exchange game. Light (radiant energy) can strike an object, and cause it to heat up (thermal energy). Or, when you bring your car to a stop in a more amiable way than slamming into something, you are actually converting its motion (kinetic energy) into the warming of the brakes (thermal energy). The next time you want a speedster to slow down a bit, try yelling as he drives by: "Hey, could you warm up the brakes a bit?" Okay, maybe just keep the scientific talk to yourself and be satisfied with understanding the concept.

Finally, on to **nuclear energy**, or "atomic" energy. I spoke of the purest energy first, but I have saved the greatest energy for last. In order to understand this, though, we must look at a major scientific law, the First Law of Thermodynamics. One way to express this decree is that "matter and energy are neither lost nor destroyed in an ordinary reaction, but only change form." In short, energy never appears or disappears, but moves around, taking on different forms, and matter also: a burning log is not destroyed, but becomes ashes and gas. That's basically what we've looked at so far: the fact that that potential, kinetic, and thermal energies are all present and interchangeable, due to the immense amount initially imparted at Creation. The same is true of matter itself. The sum total of the universe's energy, and its mass, remains unchanged since that glorious beginning.

But note the word *ordinary* in the First Law. What's the exception? The exception is when matter and energy are *themselves* exchanged, such as when matter does in fact disappear, and energy,

in turn, does appear. This is what we call a nuclear reaction, and this is where we apply Einstein's famous and familiar equation E (energy) = mc^2. Do you remember seeing the incomprehensible destruction of the cities of Hiroshima and Nagasaki which ended World War II? A relatively *small* amount of nuclear energy brought about those catastrophes, converting matter into an intense flash of light, and superheated wind (that is, radiant, thermal, and kinetic energies). If you could weigh a nuclear fission reaction (splitting of heavy atoms, such as uranium) or fusion reaction (combination of lighter atoms, such as hydrogen) after they occurred, you would find that a tiny bit of mass was lost. Matter literally disappears. In a normal reaction, this never happens. But nuclear energy is not ordinary.

This tells us something interesting. Even though only have the technology to release nuclear energy under certain conditions, with certain elements, that energy is nonetheless present, in these enormous amounts, in the atoms of *all* things. Thus, nuclear energy could be thought of as "micro-potential" energy. Remember that twelve fluid ounce glass of water? At room temperature, it had about 250,000 Joules of thermal energy. But how much *nuclear* energy does it contain? To find out, we just plug the numbers into Einstein's equation: For "m" (mass) we use the metric unit kilograms; twelve fluid ounces of water measures in at 0.355 kg. For "c" we use the speed of light, which is 3.0×10^8 meters per second. We square this number (multiply it by itself), multiply by the 0.355, and learn that our placid glass of water has a whopping 3.2×10^{16} Joules of nuclear energy contained within its atoms. Dividing this number into our thermal energy estimate for the ocean, this means that just 1,800,000 glasses of water (a 56' x 56' swimming pool, 7' deep) have as much pure nuclear energy as all the thermal energy in the ocean! Put another way: if you could "burn" the nuclear fuel in that swimming pool full of water, it would thaw out a block of ice (a *very* cold block of ice) the size of all our oceans combined.

This boggles the mind. If that much heat would be released by exchanging a little water for its pure nuclear energy, then the reverse would be true: It would take that much energy to create, out of nothing, a small pool of water. When God spoke the world into existence, he unloaded energy in a major way! And furthermore, he was not Himself spent in the process, because though it was a great act, the Creator is much greater than His Creation.

To wrap things up, let's get back to that initial word: "power." **Scientists call it "power" when energy is released per the course of time**. A weak man may be able to climb the same hill as a strong one, but it will take the weak man longer, because he is less powerful. Even if God had created everything slowly, it amounts to a huge amount of energy. But how long did it take for God to perform each mighty stage of the Creation? The biblical refrain "And God said let there be...and

there was…" indicates that His work was instantaneous. This means that, literally, **God's power (work per time) is *infinite***. So much for measuring!

Fortunately, his power is not released only in the physical realm. In fact, his physical creation ought to open our eyes to his very spiritual nature: "For since the creation of the world God's invisible qualities—his eternal power and divine nature—have been clearly seen, being understood from what has been made, so that men are without excuse" (Romans 1:20). God's power is awesome, and yet He has the power not only to create, but more magnificently, to *re*create. "I am not ashamed of the gospel, because it is the power of God for the salvation of everyone who believes: first for the Jew, then for the Gentile" (Romans 1:16). When we wonder if we can trust in God's power to transform us inwardly, we would do well to consider how much power He employed to get us—and everything—here in the first place.