EFFECT OF RADIATION PRESSURE ON MICROMETEOROIDS, AND EXISTENCE OF MICROMETEOROIDS AS EVIDENCE FOR A YOUNG SOLAR SYSTEM

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Micrometeoroids are microscopic particles of dust, which exist in abundance in the solar system, in interplanetary space. The very existence of this dust, it is shown, provides evidence that the system is young, because the dust is being removed much more quickly than it could be replenished. Were the system as old as uniformitarians claim, the dust would have been all gone long ago.

SUMMARY OF CONTENTS

There is a large body of empirical evidence for the existence of vast amounts of cosmic and solar dust in subspace. The most available observational proofs are Zodiacal Light, the F Corona, the Gegenschein glow, and actual collections of dust after large meteorite falls.

Zodiacal Light

Zodiacal Light is a faint glow along the ecliptic (the path of the Sun), conspicuous at Northern U. S. latitudes, seen in the east before sunrise, or in the west a few hours after sunset.[1] Under favorable conditions it rivals the Milky Way in brilliance. This "false dawn" shows an absorption (dark-line) spectrum which is a faint mirror image of the solar spectrum, indicating the presence of a large concentration of tiny reflecting particles in the plane of the ecliptic.[2] In order to maintain this cloud 3×10^{14} g/yr of dust particles must be supplied due to radiation losses.

"F" Corona

Another manifestation of these reflecting bodies is the outer part of the Sun's corona, denoted as the Fraunhofer, or "F" Corona. This glow, which is observed as far as nine degrees away from the Sun, is seen during solar eclipses, or by the use of the coronagraph, an instrument which simulates an eclipse.[3] Spectral analysis yields the same results as in the case of the Zodiacal Light, indicating the presence of tiny reflecting particles, around one micron (10^{-4} cm.) in size. It is suggested that the Zodiacal Light is a mere extension of the "F" Corona (sometimes called the false corona) on the ecliptic.

Gegenschein

On dark nights a glow, extending about nine by eight degrees, can be seen centered on the ecliptic exactly opposite the Sun. This "counter glow" or Gegenschein is probably due to these microglobules viewed at full phase (as the full Moon) at full illumination.[4]

Collections of Micrometeorites

In 1883 a large fall of meteoritic red dust was collected at a height of 9,850 feet near San Francisco. Subsequent analysis of this dust by Nordenskiold indicated meteoritic origin. After a bolide (an extremely large bright meteorite) fall in September, 1927, Rudaux also collected and chemically analyzed the consequent dust.[5] In 1933 an especially rich collection of cosmic dust was made during a well-known meteor shower on October 9.[6]

Using air-borne magnets, Nininger, in 1940, extracted spherical particles with a mean diameter of 9×10^{-3} cm and a composition almost entirely of nickel. Based on the numerous and varied collections, most micrometeoritic globules range from 5×10^{-4} to 3×10^{-3} cm.[7]

Abundance of Micrometeorites

All of these preceding findings and observations indicate that a great abundance of micron-sized subspace particles exists in the solar system. Estimates of the number of micrometeoroids vary greatly, from 100 to 1,000 per cubic mile.[8] However, probably a great range in the density of dust should be expected throughout planetary space due to meteoroid swarms; gravitational effects with comets, planets, etc.; and great concentrations in the asteroid belt.

Abundance of Cosmic Dust

Likewise, outside the solar system the vast distances of interstellar space are filled with immense quantities of dust and gas.[9] In the Milky Way, alone, the total amount of cosmic dust is estimated at 3×10^{8} earth masses (6×10^{35} g). Observations indicate that the sizes of these particles are on the order of 5×10^{-5} cm (micrometeorite size).[10] The galactic density of these particles is generally one per cubic

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centimeter, while denser clouds (as in nebula) may exceed this figure by 1,000 times.[11]

Composition, Density, and Albedo

E. L. Krinov stated that "particles of meteoritic dust maintain the composition and microstructure peculiar to meteorites."[12] Most meteorites are iron-nickel in content with a small abundance of silicates. Nordenskiold indicated from his investigation of the San Francisco fall that the composition of the red dust was Fe-92.3% and Ni-7.6% (if oxides are converted to metals), which is analogous to the composition of iron meteorites.[13] J. D. Buddhue, in carefully planned meteoritic dust collection experiments at various well-chosen geographic locations in the U. S. obtained a mean specific gravity of 4.422 (silicates and magnetite with traces of nickel).[14] Usually the albedo (reflectivity as compared with a perfect reflector) is low,[15] averaging probably 0.2. In composition and microstructure, cosmic dust (subgalactic) cannot be distinguished from meteoric bodies (interplanetary).

Radiation Pressure on Cosmic Dust

J. H. Poynting, in 1905, stated that "in all cases of energy transfer (including wave phenomena), momentum is passed on in the direction of transfer," producing radiation pressure by imparting momentum to particles in its path. Earlier work by Dr. Barlow showed agreement with this in actual laboratory experiments.[16] H. P. Robertson (1968) restated this principle as simply, "Stellar radiation flushes particles out of the galaxy."[17]

In the case of motion in a field of uniform, unidirectional radiation in which the particle starts from rest at the origin of a radiation field, relativistic equations for our galaxy have been developed.[18] These equations simply estimate the rate at which stellar radiation flushes particles out of the galaxy.

$$\frac{V}{c} = \frac{1}{1+\frac{1}{RT}}, \frac{1}{R} = \frac{10^{16}ad}{7} (yr\ cm^2 g^{-1}) \tag{1}$$

where a is the radius of the cosmic particle, d is its specific gravity, v is the velocity of recession, c the speed of light; and T is the time interval.

If the average micron-sized particle is $a = 5 \times 10^{-5}$ cm, with an average density of $d = 4.4$ g.cm, observations of cosmic dust in our galaxy show that these particles are in essentially static configurations; hence velocities should be small according to these equations. If $T = 6 \times 10^3$ yr. (6,000 years), which is the Biblical estimate for the age of the earth, $v = 6 \times 10^2$ cm/s or about 14 miles per hour. Cosmic dust is nearly stationary in this calculation.

However, on substitution of $T = 10^{10}$ yr. (10 billion years), which is the typical estimate for the age of the galaxy made by uniformitarians, then subspace velocity is 0.032 c, about 21 million miles per hour since $c = 3 \times 10^{10}$ cm/s. It must be admitted that particles supposedly travelling at 21,000,000 miles per hour would not be "essentially static."

Age of the Galaxy

A particle traveling at 0.032 c would travel one light-year in 32 years and would leave the galaxy, the diameter of which is about 100,000 light-years, in 1.6×10^6 yr, i.e., about two million years. Hence, in only a short time, compared with the supposed age of the universe, the galaxy would be swept clean of cosmic dust. How, using this model, could one possibly account for the heavy abundance of dust in the galaxy?

Poynting-Robertson

The second effect mentioned by J. H. Poynting in his 1905 article was that radiation pressure in the solar system causes particles to move in decreasing orbits, finally spiraling into the Sun.[19] This is the well-known Poynting-Robertson effect.

H. P. Robertson states that isotropic (in all directions) radiation by particles in the solar system causes particles to experience more intense flux when it moves against radiation than when it moves with the radiation.[20] Further, the total force per unit mass acting on such particles moving perpendicularly to a radiation field would have both radial and tangential components.

Simply, a particle in orbit about the Sun is given an outward radial push by radiation pressure. The particle, moving at a constant orbital speed, cannot move to a more distant orbit due to Kepler's third law, if the gravitational pull is greater than the radiation pressure. However, due to the radiation field and isotropic re-radiation from the particle, the particle is influenced by a "bunching up" of waves in the direction of its motion and a spreading of waves behind it. This results in deceleration and consequent orbital decay (also due to Kepler's third law).

Relativistic orbital equations show that the orbit of a particle eventually shrinks under the influence of solar radiation; and the orbit also becomes more and more nearly circular.[21] The amount of time t in which the radius of an orbit changes from its initial value r to zero (i.e., collision with the Sun) is given by the relation:[22]

$$t = \frac{r^2}{4A}, A = \frac{2.5 \times 10^{11}}{ad} (g\ s^{-1}) \tag{2}$$

As a secondary consequence of radiation, Dr. Poynting demonstrated that radiation pressure produces an observable effect on particles smaller than 10^{-3} inches in diameter since:

$$\frac{P}{G} = \frac{k}{a} \tag{3}$$

where P is the radiation pressure, G is the gravitational force, and k is a constant. For particles of size 10^{-5} inch, the radiation pressure and the gravitational force become equal, so that $R/G = 1$.[23] (So he thought then; later 10^{-5} was found to be somewhat large. See equation 4).

Robertson, likewise, found that:

$$P = \frac{k}{ad} \tag{4}$$

where $ad = 5.7 \times 10^{-5}$ g cm^{-2} is the critical value at which radiation pressure exactly balances solar gravitation. For *ad* greater than this value the particle spirals toward the Sun, for *ad* less it is repelled from the solar system.

Thus the Poynting-Robertson effect is insignificant for all but very minute particles. A particle as large as one centimeter would take 20,000,000 years to fall into the Sun from the Earth's orbit. For objects as large as planets, there is no effect at all. By a simple substitution, evidently 10,000 trillion years would have to transpire before the Earth would plunge into the Sun!

Age of the Solar System

Another interesting piece of information is the number of revolutions which a particle in the solar radiation field makes before striking the Sun from a distance of one astronomical unit (*AU*, the semi-major axis of the Earth's orbit or its mean distance from the Sun):

$$N \simeq 2.8 \times 10^7 a \qquad (5)$$

Again, by applying equation 2 to a typical micrometeoridic particle of size 5 x 10^{-5} cm, density 4.4, and original orbit of radius 1 *AU*, $t = 4.95 \times 10^{10}$ s, about 1,600 years. Thus all the average micrometeoroids at or inside the earth's orbit would have fallen into the sun in less than two millenia. To fit in with the age of 6,000 years, it must be that the particles which now exist around the Earth's orbit were originally trans Earth-Mars particles. They have since lost momentum and moved closer to the Sun, being now around the Earth's orbit.

If a typical micrometeoroid were located 2.8 *AU* from the Sun, in the center of the asteroid belt, which is the area of heaviest concentration of such particles, then by calculation, $t = 4.15 \times 10^{11}$ s, about 13,800 years. Such micrometeoroids, then, would have been engulfed into the Sun in less than 14,000 years. In fact, in less than 2.5 million years, the entire solar system from the Sun to Pluto would be sterilized of micrometeoroids.

Based on this simple algebra, it is evident that the entire solar system as well as the galaxy would be "vacuumed and swept clean" of subspace dust in a time period not even remotely resembling 10 billion years. Rather, these results fit in nicely with a universe of age 6,000 years.

Effect of the Solar Wind

It must be noted that the additive effect of the solar wind has not been considered. Solar wind consists of a massive stream of ions, principally protons, which are thrown out of the Sun at average velocities of 300 to 400 km/s (maximum 2,000 km/s), and have ion densities of 10 to 20 particles per cubic centimeter (maximum 10^4/cm during heights of solar activity). These ions make an appreciable contribution to the decay of orbits.[24]

Production of Particles by Disintegration of Comets

Observational evidence shows that meteoroidic matter is in a stationary state.[25] However, nearly a ton of interplanetary dust falls into the Sun each second (80,000 tons per day). Due to this loss, Fletcher Watson, a noted planetary specialist, stated: "Obviously we must search for some means of maintaining a steady supply of new dust particles."[26] His first mechanism for maintaining densities of dust over vast cosmological ages was Comet Disintegration.

Rate of Ejection of Dust from Comets

Halley's comet is known to have lost 30 tons of material per second as it passed the Earth early in this century.[27] Dr. Fred L. Whipple, originator of the Comet Disintegration mechanism, has shown that a giant comet, having a nucleus 10 to 20 miles in diameter, does release 30 tons of matter per second during a close approach to the Sun.[28] Of this total, however, only a fractional part by mass is of micrometeoroid size. A more recent study by Lebinets (1970) indicates that the rate of ejection of dust of all long-period comets (usually more massive) is equal to a mere 10^{15} g/yr. (0.04 tons per second).[29]

Moreover, only a small fraction of the dust survives the gravitational disturbances of the planets in order to contribute to "free" interplanetary space.[30] Watson's use of Halley's comet as an example of comet disintegration was a poor choice. Of the known comets, few are as large as Halley's; rather nuclear diameters are usually about one mile, and the mass 0.001 to 0.00025% that of Halley's. Finally, comets emit large quantities of mass only during the relatively short intervals when they are near the Sun.

Comets would not even be in existence today, if the universe were 10 billion years old, due to their short cosmic lifetimes and consequent disintegration into meteor showers. Due to the existence of meteor showers which have replaced dissipated comets, such as Comet Biela, one must conclude that a large percentage of particles produced by disintegration stay in the comet's solar orbit and are not available for solar accretion. For all these reasons, the disintegration of comets cannot be a major source of micrometeoroid particles.

Collisional Crushing

Collision crushing (particles involved in cataclysmic collisions) was Watson's second mechanism for meteoric production. He stated: "Perhaps 20 to 60 tons of material per second" are produced in this way.[31] In the vicinity of the Earth's orbit there are 100 to 1,000 particles per cubic mile. At the upper limits of 1,000 per cubic mile, evenly dispersed particles in such a situation would be over 500 feet from their nearest neighbors. How many tons of material would be produced by collisions of particles with a mass on the order of 10^{-13} kg and diameters of 10^{-4} cm, spaced 1.5 x 10^5 cm apart? As for particles greater than 2 x 10^{-4} g that might produce micrometeoroids by collisions, 10^{-5} particles exist in one cubic kilometer in the vicinity of the Earth's orbit.[32] Only ten bodies of this type exist inside a hundred-kilometer cube. Possible collisions would be decidedly rare.

Crushing in the Asteroid Belt

According to Dohnanyi's statistical analysis[33] of crushing effects in the dense area of the asteroid belt (total mass 10^{21} kg), particles of micrometeoroid size have lifetimes (intervals between collisions) on the order of 10,000 to 100,000 years with regard to catastrophic collisions. Particles of mass greater than 2×10^{-4} g have lifetimes of one million to billions of years.[34]

If collisions are so rare even in dense regions, how does the production of micrometeoroids keep up with the gigantic amounts of dust lost to the Sun annually? Dohnanyi's calculations show a total crushing of 10^{12} kg of material for micrometeoroids ranging in mass from 10^{-18} to 10^{20} kg (objects 10^{-6} cm to 100 km in diameter); of which micrometeoroids contribute almost nothing (less than 0.01% by mass).[35]

By using an average of 800 micrometeoroids per cubic mile over the entire solar system (which is probably a gross over-estimate) a total mass of 10^{19} kg is calculated. The existence of a dense cloud of dust about the Sun ("F" Corona, Zodiacal Light), in connection with the Poynting-Robertson effect on bodies smaller than 10^{-3} cm, shows that most of the 80,000 tons (7×10^{7} kg) of material lost to the Sun daily consists primarily of micrometeoroids. Thus there is a yearly loss of 2.5×10^{10} kg of such particles.

If one extrapolates this loss backward into time for 10^{10} years (linear extrapolation, even though this function is inherently logarithmic), the solar system would have 26 times the present amount of dust. This would be enough matter to construct a giant minor planet, of diameter 210 km (larger than Juno); which is analogous to constructing the Earth out of beach sand a grain at a time!

Cosmic Eons?

It has been demonstrated that, in only 2.5 million years (a very short time on the supposed cosmic scale of 10 billion years), the entire solar system and galaxy would be void of meteoric dust. This implies that there should be virtually no dust in the observable universe at present, except the puny amounts produced by recent collisions. Other calculations have shown that radiation pressure acting over vast cosmic ages would cause dust particles to have velocities approaching that of light.

Such wild extremes conflict directly with observations that sub-space particles are essentially static. Would it not be easier to cease to hypothesize possible continuous mechanisms for the "creation" of particles in vast amounts over eons of time, and accept the simple conclusions consistent with a young Earth?

Conclusion: a Young Earth

If the Earth, solar system, and galaxy are considered to be about 6,000 years old, only a small portion of the original micrometeoroids have been lost to the Sun (less than 0.2%). Also, the velocities of cosmic dust particles are now a mere 14 miles per hour, which does not differ appreciably from random motion. Thus, belief in a young Earth—and young universe—is in accord with the observed facts.

These topics have been a battleground for heated discussion, and this is especially so with respect to the Poynting-Robertson effect since 1903. The battles have occurred in discussions, articles, and books. Second Timothy 3:7 states that men (and surely this applies to evolutionists) are "ever learning, and never able to come to the knowledge of the truth." Again, at the end of the first epistle of Timothy, Christians are warned that they should be "avoiding profane and vain babblings and oppositions of science falsely so called." For the creationist, however, all such oppositions have no grounds; and true science can easily rest on the basis of the Word of God.

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