June 18, 1993 letter from Brown to Morris

CSC

CENTER FOR SCIENTIFIC CREATION

5612 N. 20th Place, Phoenix, Arizona 85016 • Phone: (602) 955-7663
email: walt@creationscience.com • CSC online: www.creationscience.com

WALTER T. BROWN, JR., Ph.D.
Director

Dr. Henry M. Morris
Institute for Creation Research
P.O. Box 2667
El Cajon, CA 92021

June 18, 1993

Dear Henry,

This festering problem with Austin is just one more example of why I wrote you a six-page letter on March 13, 1991. There are other examples of inaccurate and derogatory "slams" at me (behind my back) and plagiarism coming out of ICR. The enclosed portion of an ICR book, when compared with the enclosed work Stacey published eleven years earlier, is a clear case of plagiarism. After thirteen years, you are still selling that ICR book. For over ten years, I am still hearing second- and third- hand reports that ICR is spreading inaccurate, derogatory, but usually vague, reports about me. Last week, I learned of a person in a foreign country, who heard and believed one of these ICR stories. He is refusing to work with a prominent creationist in the United States, in part because that creationist is working with me.

Both plagiarism and slander (false witness) are serious matters for ICR, and would shock tens of thousands of people. These problems deserve your personal and forthright attention. I have written to you in some detail about similar problems before but have seen no indication of concern or action. Please don't underestimate the seriousness of this or my resolve to correct these matters. I hope you can understand my deep concern and will assure me that this will not happen again.

Henry, without your involvement, Austin (and consequently ICR) might be tempted to ignore, rationalize, or think he is "above" the problems I addressed in my letter to him. If Austin is spreading stories that I have plagiarized, then that alone would cause ICR people to spread derogatory comments about me. If so, you and I must do our best to rectify the matter. Otherwise, the creation movement will suffer.

If these problems had occurred in my research organization, which was ten times larger than ICR, I would have taken a personal and intense interest in solving them. If Austin has done what people have told me, if he was anywhere in my research laboratory, and if he wasn't extremely repentant, I would consider releasing him. Please let me know by July 19th how you intend to rectify matters.

Sincerely,

Walt

Walt

See pages 57-59

age of the cosmos

by

HAROLD S. SLUSHER, M.S., D.Sc.

Assistant Professor of Physics
University of Texas at El Paso
and
Research Associate,
Institute for Creation Research
San Diego, California

ICR Technical Monograph No. 9

Institute for Creation Research
San Diego, CA 92116

AGE OF THE COSMOS

Institute for Creation Research
2716 Madison Avenue
San Diego, CA 92116

Library of Congress Catalog Card
Number 79-92722
ISBN 0-932766-03-X

Cataloging in Publication Data
Slusher, Harold Schultz, 1934-
Age of the Cosmos.
1. Cosmogony 2. Cosmology I. Title
523.12 79-92722

ISBN 0-932766-03-X
Printed in United States of America

THE AUTHOR

HAROLD S. SLUSHER, M.S., D.Sc.

Professor Harold S. Slusher earned his B.A. from the University of Tennessee (mathematics and physics) and his M.S. from the University of Oklahoma (physics and astronomy). In 1975 he was awarded an honorary D.Sc. degree by Indiana Christian University in recognition of his work on the time scale for the cosmos. For many years he served as Director of the University of Texas at El Paso Kidd Memorial Seismic Observatory. He is Assistant Professor on the faculty of the Department of Physics at the University of Texas at El Paso and also serves as Research Associate in Geoscience and Astronomy with the Institute for Creation Research and is Adjunct Chairman of the Department of Physical Sciences at Christian Heritage College.

Professor Slusher's fields of interest and research include solar system astronomy, terrestrial heat flow, and cosmogony. In addition to this monograph *Age of the Cosmos,* he has also written other Institute for Creation Research monographs: *A Critique of Radiometric Dating, The Origin of the Universe: An Examination of the Big Bang and Steady-State Cosmogonies, The Age of the Solar System: A Study of the Poynting-Robertson Effect and Extinction of Interplanetary Dust,* and *The Age of the Earth: A Study of the Cooling of the Earth Under the Influence of Radioactive Heat Sources.*

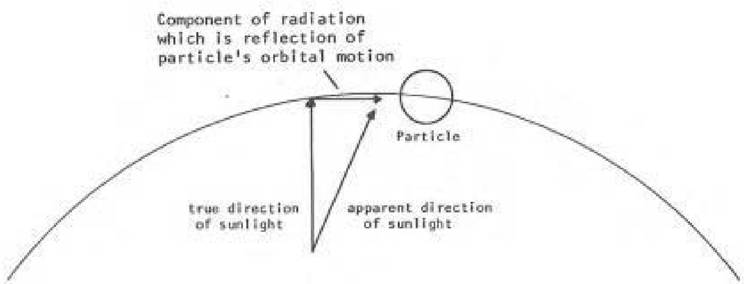

Figure 6.

slowly settles into a smaller and smaller orbit, spiraling in toward the sun. This effect was first predicted by the British physicist Poynting (1903) and was later amended and analytically verified by the American physicist Robertson (1937).

Consider a grain of dust orbiting about the sun in interplanetary space. It absorbs sunlight, and re-emits this energy isotropically. We can view this two-step process from two different standpoints.

1. As seen from the sun, the particle absorbs light coming radially from the sun and re-emits it isotropically in its own rest frame. A re-emitted photon carries off angular momentum proportional (i) to its equivalent mass ($h\nu/c^2$), (ii) to the velocity of the grain ($R\dot{\theta}$), and (iii) to the grain's distance from the sun (R). In these equations ν is the frequency of the radiation, h is Planck's constant, $\dot{\theta}$ is the angular velocity of the grain about the sun, and c is the speed of light in a vacuum. The grain loses orbital angular momentum L about the sun at a rate of approximately

$$dL = \frac{h}{c^2}\nu\dot{\theta}R^2 \text{ OR } (1/L)\,dL = \frac{h\nu}{mc^2}$$

for each photon whose energy is absorbed and re-emitted, or isotropically scattered in the grain's rest-frame. The grain's mass is m.

2. Seen from the grain, radiation from the sun comes in at an aberration angle, $90° - \theta$ from the direction of motion of the grain. If V is the speed of the particle in a circular solar orbit, the angle (θ) between the incoming radiation and the radius vector to the sun is $\theta \approx V/c$. Here V is $\dot{\theta}R$, the grain's orbital velocity. Hence the photon

imparts an angular momentum $pR\sin\theta = \frac{h\nu}{c^2}R^2\dot{\theta}$ to the grain where p is the momentum of the photon.

For a grain with cross section σ,

$$dL/dt = \frac{-L_\odot}{4\pi R^2}\;\frac{\sigma L}{mc^2}$$

where $L_\odot$ is the solar luminosity.

In either approach the grain velocity decreases on just absorbing the light. From the first viewpoint because the grain has gained mass which it then loses on re-emission; from the second, because of the momentum transfer.

3. A third way of arriving at the Poynting-Robertson effect on a particle and the time of its spiralling inward to the sun may be obtained rather simply in the case of circular orbits in the following manner.

Consider the special case of a spherical particle of mass m and diameter d in a circular orbit of radius r. Its orbital speed may be found from the relation:

from S[illegible], p. 14-16

(Centripetal Force) = (Gravitational Force)

$$\frac{mv^2}{r} = \frac{mGM}{r^2};$$

$$v = \left(\frac{GM}{r}\right)^{1/2}$$

M is the mass of the Sun and G is the gravitational constant. The total orbital energy is E = (Potential Energy) + (Kinetic Energy),

$$E = -\frac{GMm}{r} + \tfrac{1}{2}mv^2 = \frac{-GMm}{2r}$$

Let us consider separately the processes of absorption and re-radiation of energy.

In time dt the particle receives energy $d\varepsilon$ as solar radiation. This causes an increase in mass $dm = \frac{d\varepsilon}{c^2}$. But since this radiation

$$E = \frac{-GMm}{2r} + \frac{1}{2}m\left(\frac{GM}{r}\right) = \frac{GmM(-2+1)}{r}$$

$= \frac{v r \, d\varepsilon}{c^2}$

traveled radially from the sun, it carried no orbital angular momentum and the total orbital angular momentum of the particle is conserved so that H = mvr = constant;

$$dH = md(vr) + vr\,dm = 0; \quad md(vr) = -vr\,dm = \frac{-v}{c^2} r\,d\varepsilon.$$

The particle then reradiates the energy $d\varepsilon$, but it does so isotropically in its own frame of reference and this process involves no reaction on the particle. The orbital velocity is therefore conserved in the radiation process and since the mass dm is lost, a net loss of angular momentum by v r dm occurs. This angular momentum is carried away by the radiation which, when viewed in the stationary reference of the sun, is seen to be Doppler-shifted; the energy and momentum projected forward from the particle exceed the energy and momentum radiated backward.

The rate of loss of orbital radial angular momentum may be equated to a retarding torque

$$\tau : \tau = \frac{md(vr)}{dt} = \frac{-v}{c^2} r \frac{d\varepsilon}{dt} \quad \text{so that } \frac{dE}{dt} = \tau \frac{v}{r} = \frac{-v^2}{c^2} \frac{d\varepsilon}{dt}$$

Now $d\varepsilon/dt$ is the rate at which the particle receives solar radiation and is given by

$$d\varepsilon/dt = S\left(\frac{r_E}{r}\right)^2 A$$

where S is the solar constant or the energy flux normally through unit area at the distance r_E of the earth's orbit ($S = 1.39 \times 10^6$ ergs/cm²-s), and $A = (\pi/4)d^2$ is the cross-sectional area of the particle. By differentiating E with respect to t and equating this to

$$dE/dt = \frac{-v}{2} \frac{d\varepsilon}{dt}$$

we obtain the relation $\frac{GM}{2r^2} \frac{dr}{dt} = \frac{-v^2}{c^2} S\left(\frac{r_E}{r}\right)^2 A.$

But $v = \left(\frac{Gm}{r}\right)^{1/2}$ so that we get $r\frac{dr}{dt} = -\frac{2Sr_E^2}{Mc^2} A.$

Integrating from the initial condition, $r = r_o$ at $t = 0$;

$$\frac{r_o^2 - r^2}{r_E^2} = \frac{4SA}{Mc^2} t$$

which, for a spherical particle of

density ρ, becomes $\left(\frac{r_o}{r_E}\right)^2 - \left(\frac{r}{r_E}\right)^2 = \frac{6S}{d\rho c^2} t$

where r/r_E is the radius of a particle orbit expressed in astronomical units.

Table II lists the names of falls for particles of various sizes and orbits calculated with more complete formulas which include the eccentricity.[23] The Poynting-Robertson effect would seem to be quite efficient in rapidly clearing the solar system of dust material. But the solar system is quite "cluttered" with dust and gas material.

TABLE II
(after Wyatt and Whipple)
Times of fall for particles with various orbits

a, AU	e (eccentricity)	t/ (10^7 yr × d/2ρ)	Type of Orbit
3	0.0	6	asteroidal
3	0.7	0.7	asteroidal
1.4 (Geminids)	0.9	0.14	meteor showers
3.5 (Bielids)	0.7	3	meteor showers
10 (Leonids)	0.9	7	meteor showers
55 (Lyrids)	0.98	20	meteor showers

The Poynting-Robertson effect causes a general reduction in the eccentricity and major axes of small bodies in orbit about the sun until, other circumstances permitting, they spiral near the sun to sublimate. The time of spiraling into the sun for a black, or perfectly reflecting, spherical particle of radius d/2 and density ρ in an orbit of perihelion distance q(inAU) is given by the following equation: spiral time $= C(e)\frac{\rho d q}{2} \times 10^7$ yr where the factor C(e) depends solely upon the orbital eccentricity e.

B. Some Calculations of Spiral Times of Particles in Circular Paths

To show some of the times for particles of different sizes to spiral into the sun from initial circular orbits about the sun we can use the equation

$$t = 7 \times 10^6 \frac{\rho d r_o^2}{2}$$

(years) where the particle radius d/2 is in centimeters, the particle density ρ is in gm/cm³, and the particle distance r_o is in astronomical units. Assume a particle density of 2.7 gm/cm³ for these calculations. Table III lists the results of these computations.

1.4 The Poynting-Robertson Effect

Solar radiation has an important influence on the orbits of small particles whose ratio of surface area to mass is large. Its effects on the meteor streams have been studied in detail and a historical and physical discussion is given by Lovell (1954). Particles up to about 10 cm diameter are affected on a time scale of 10^9 years.

It is convenient to distinguish three effects of solar radiation pressure, although they are not really independent. First, there is a simple outward force from the Sun. For particles with diameters of a few thousand Angstroms or less this force may exceed the gravitational attraction of the Sun and blow them out of the solar system. This problem is complicated by the fact that the critical particle size is comparable to the wavelength of the radiation and the effective optical cross section is not the simple physical cross section. We are concerned here with much larger particles. Second, the solar radiation received by a particle is Doppler-shifted to cause an increase in radiation pressure if the particle is approaching the Sun and a decrease if it is receding; elliptical orbits are thus reduced to nearly circular orbits. Third, the angular momentum of an orbiting particle is progressively destroyed by the fact that it receives solar radiation, which has only a radial momentum from the Sun (neglecting the solar rotation), and reradiates this energy with a forward momentum corresponding to its own motion about the Sun. This is the essential feature of the Poynting-Robertson effect, which is most conveniently analyzed as a problem in relativity.

We consider the special case of a spherical particle of mass m and diameter d in a circular orbit at radius r. Its orbital velocity is

$$v = \left(\frac{GM}{r}\right)^{1/2} \tag{1.6}$$

M is the mass of the Sun and G the gravitational constant, so that the total orbital energy is

$$E = -\frac{GMm}{r} + \frac{1}{2}mv^2 = -\frac{GMm}{2r} \tag{1.7}$$

It is convenient to consider separately the processes of absorption and reradiation of the energy.

In time dt the particle receives energy $d\epsilon$ as solar radiation, and this causes an increase in mass

$$dm = \frac{d\epsilon}{c^2} \tag{1.8}$$

c being the velocity of light. But since this radiation traveled radially from the Sun it carried no orbital angular momentum and the total angular momentum of the particle is conserved, so that

$$m\,d(vr) = -vr\,dm = -\frac{v}{c^2} r\,d\epsilon \tag{1.9}$$

The particle then reradiates the energy $d\epsilon$, but it does so isotropically in its own frame of reference and this process involves no reaction on the particle. The orbital velocity is therefore conserved in the radiation process and since the mass dm is lost, a net loss of angular momentum by $vrdm$ occurs. This angular momentum is carried away by the radiation, which, when viewed in the stationary reference frame of the Sun, is seen to be Doppler-shifted; the energy and momentum projected forward from the particle exceed the energy and momentum radiated backward.

The rate of loss of orbital angular momentum may be equated to a retarding torque L:

$$L = m\frac{d(vr)}{dt} = -\frac{v}{c^2} r \frac{d\epsilon}{dt} \tag{1.10}$$

so that

$$\frac{dE}{dt} = L\frac{v}{r} = -\frac{v^2}{c^2}\frac{d\epsilon}{dt} \tag{1.11}$$

Now $d\epsilon/dt$ is the rate at which the particle receives solar radiation and is given by

$$\frac{d\epsilon}{dt} = S\left(\frac{r_E}{r}\right)^2 A \tag{1.12}$$

where S is the solar constant, the energy flux through unit area at the distance r_E of the Earth's orbit, 1.39×10^6 ergs cm^{-2} sec^{-1} (1400 wm^{-2}), and $A = (\pi/4)\,d^2$ is the cross-sectional area of the particle. Thus by differentiating Eq. (1.7) and equating to Eq. (1.11) with the substitution of Eq. (1.12) we obtain

$$\frac{GMm}{2r^2}\frac{dr}{dt} = -\frac{v^2}{c^2} S\left(\frac{r_E}{r}\right)^2 A \tag{1.13}$$

and since v is given in terms of r by Eq. (1.6), we obtain the differential equation for r:

$$r\frac{dr}{dt} = -\frac{2Sr_E^2 A}{mc^2} \tag{1.14}$$

Integrating from the initial condition, $r = r_0$ at $t = 0$:

$$\frac{r_0^2 - r^2}{r_E^2} = \frac{4SA}{mc^2}t \tag{1.15}$$

$(2.7)^2 - 1^2 = 6\left(1.39 \times 10^6 \frac{\text{ergs}}{\text{cm}^2\,\text{sec}}\right) \frac{\text{cm}^3}{d\ 4\,\text{gm}\ 9 \times 10^{20}\,\text{cm}^2}$

$= \frac{6 \times 1.39\, t}{4 \times 9 \times 10^{7} d}$

which, for a spherical particle of density ρ, becomes

$t = \frac{[(2.7)^2 - 1] \times 36 \times 10^{7}}{3600 \times 24 \times 365}\, d$, years

$$\left(\frac{r_0}{r_E}\right)^2 - \left(\frac{r}{r_E}\right)^2 = \frac{6S}{d\rho c^2}\, t \tag{1.16}$$

Slusher

where (r/r_E) is the radius of a particle orbit, expressed in astronomical units (AU).

We are interested in the time taken by particles, of diameter d, originating in the asteroidal belt at $2.7\, r_E$, to reach the Earth's orbit, r_E. Assuming a particle density of $4\ \text{gm/cm}^3$ and d in centimeters, this is

$t = 8.6036\, d \times 10^7$ years

$$t = 8.6 \times 10^7\, d \text{ years} \tag{1.17}$$

A more complete analysis (Lovell, 1954, pp. 402–409) shows that a particle in an elliptical orbit is first reduced to a nearly circular orbit, just inside its initial perihelion distance. Since this process also depends upon the Doppler shift of radiation due to motion of the particle relative to the Sun, the time required is similar to that for the spiraling effect.

The Poynting-Robertson effect thus ensures that any small particles in the common meteoroid range (less than 1 cm diameter), which originated in the asteroidal belt about 10^8 years ago, would have passed the Earth's orbit and spiraled into the Sun. McKinley (1961, pp. 169–171) has pointed out that very few meteors appear to be due to particles having the density of stone or rock. They are envisaged as loose, dusty aggregates, similar to the supposed structures of comets and quite different from the meteorites. The relative rarity of very small meteorites is consistent with the conclusion that they must be products of recent asteroidal collisions. Further, we can see that if a primary asteroidal fragmentation had occurred very early in the history of the solar system, say 4×10^9 years ago, then all primary fragments smaller than 50 cm would have spiraled into the Sun and the terrestrial collection would be strongly biased toward the shorter cosmic ray exposures of more recent, secondary fragmentations. Thus the currently available exposure age data do not permit us to decide whether the meteorites originated in one or two fairly large or many smaller parent bodies. Although the complexity of the chemical evidence appears to demand at least four parent bodies, semi-independent physical evidence is very desirable.

1.5 Compositions of the Terrestrial Planets

In spite of their uncertain mechanical histories, meteorites have had a profound influence upon our ideas about the composition, internal structure, and history of the Earth. They provide us with samples of the compositions of the terrestrial planets which are far more representative of the planets as as whole than are the rocks to which we have access near the surface of the Earth. Chemical considerations now dominate the discussion of the nature and