Creation Research Society Quarterly

Haec credimus: For in six days the Lord made heaven and earth, the sea, and all that in them is and rested on the seventh.— Exodus 20:11

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COVER ILLUSTRATION

One of the most striking examples of extinction is that of the mammoths, which have left many remains in Alaska, Siberia, and elsewhere. The picture on the cover, which was obtained for the *Quarterly* by Jody Dillow, is an artist's impression of a mammoth. This was drawn for Pfizenmayer, who was a member of the party which excavated and studied the mammoth found along the Beresovka River in Siberia about 1901.

For more about this mammoth, see the article by Dillow elsewhere in this issue of the *Quarterly*. It is shown that whatever happened to the mammoth must have been catastrophic, although the exact nature of the catastrophe is not yet clear.

ANOTHER LOCATION OF THE QUARTERLY

Dr. Albert S. Anderson, CMCF, Bible Science Library, 19 Gallery Centre, Taylors, South Carolina 29687, has written that he has all the volumes of the *Quarterly* at the address given. They are available for reading and research on the premises, but there are no facilities for loan off the premises.

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HOTROD HELICOPTER

WILLIS E. KEITHLEY* Received 18 December 1976



Figure 1. A hummingbird at the nest.

While most birds sing, this one just hums; but is hardly a humdrum!

Though other birds have only the forward look, this one flies backwards and sideways. The hummingbird is one of the few birds with a reverse gear.

Although the half-pint hen weighs only 1/14 of an ounce, she has much in common with a modern helicopter. The ratio of fuel consumption-to-weight is about the same. She also cants her wings in much the same manner as the rotor to achieve lateral and backward flight.

The hummer's rate of metabolism is exceeded only by the shrew. Thus, she must feed almost constantly. But unlike the shrew, she cannot see to feed at night as birds have no rods in the retina for night vision. To meet that problem this button-size female bird drops her vital processes down to a state of hibernation each night.

The nest of this pint-size petite is unique in many ways (Figure 1). Hardly any larger than a postage stamp, the nest is fabricated from thistledown and roped to the limb with cobwebs. If available, the female will transplant living lichens on the outside for perfect camouflage.

Source of Remarkable Abilities?

Whence came these remarkable abilities? One leading scientific publication glibly gives this astonishing answer,

Birds are able to become flying machines largely through the evolutionary gifts of feathers, wings, hollow bones, warm-bloodedness, a remarkable system of respiration, a large heart and powerful breast muscles.¹



Figure 2. A hummingbird prepares to take off.

So evolution is now some benevolent philanthropist! While etiquette frowns upon a critical attitude toward gifts, here is a miraculous (?) donation which demands a second look.

Consider first the "gift" of feathers. This favor, as well as those other gratuities, was not given on the installment plan. Rather, feathers appeared (if you'll pardon the pun) full-fledged. That quill is considered stronger for its weight than any structure designed by man. Yet flexibility of the quill allows the primary feathers at the wing-tip to bend upward with each downbeat of the wing; thus, producing the equivalent of pitch in an airplane propeller. Throughout the entire wingbeat cycle the quill is continually changing its shape to meet the requirements of air pressure and wing position. That automatic adjustment is accomplished by a unique innovation of feather design.

The leading vane of the feather is narrower than the trailing vane; thus, as the wing beats downward against the air, the pressure against the wider rear vane forces it upward to the proper angle. There it begins to operate as a propeller to give both lift and propulsion.

But feathers would be of little flight value without a wing to activate them. Which came first; were the feathers an outright gift to the wing, or vice versa? At any rate, that double-jointed foresail operates superbly to provide unequaled efficiency. The inner half of that yard-arm slopes at a slight angle like the wing of a plane to give lift, while the outer half has the driving force of a propeller.

In addition to all this is the JATO (jet-assisted takeoff) mechanism. At the "wrist" or junction of the two parts of the wing is a little tuft of feathers called the alula. As this is raised, the slot that is formed adds an extra airfoil surface for more lift and control in landing and takeoff (Figure 2).

^{*}Willis E. Keithley, an evangelist and nature photographer, receives mail at 1819 Northwest 25th, Lincoln City, Oregon 97367.

Now Add Wings, Hollow Bones

It now becomes necessary to add another fully developed endowment—the muscle to activate the wing. This muscle may be so enlarged as to account for half of the bird's weight. In the case of the hovering hummingbird, almost three-fourths. The muscle also demands other supportive systems including a higher rate of metabolism, a higher temperature and blood pressure, and a hyperactive heart. The hummingbird pounds out 615 beats per minute compared to man's 72, and this fifty-fold increase makes the human living rate look like slow motion.

Perhaps the greatest boon given to the hummingbird is the "remarkable system of respiration" and hollow bones. The two must be considered together as the functions of each interact. It is well known that a cylinder is the strongest structural unit that can be devised. Hollow bones therefore are the most efficient girders for the avian framework to give the greatest strength with the least weight.

But those hollow bones also serve another purpose; combined with an ingenious air sac system the hollow bones provide buoyancy, a reservoir for respiration and an air-conditioner to cool that hot, hopped-up metabolism. Only about one-fourth of the air intake is used for breathing while the rest is used for cooling.

The supercharger is activated by the resilient rib cage as it is compressed with each wingbeat to force air into the respiratory system. Since the air flows through the lungs in only one direction there is a continuous supply of fresh oxygen which is necessary for such hyperactivity. This contrasts sharply with man's inefficient in-and-out breathing which mingles the stale air with the fresh. Why was human kind not so endowed?

Further advantages of this needle-nosed mini-jet could include streamlining for speed, retractable landing gear, sense of camouflage, migrational navigation and its volitional power to induce hibernation (tran-

Chance Versus Creator

scendental meditation?).

But somehow the evolutionary concept of gratuitous gifts just does not "get off the ground" in spite of all the aerodynamics involved. Where is the evidence for intermediate forms? The odds for all the hummingbird functions to appear at the same time by mere chance would be astronomical. And the functions would have to be coincidental to be operational. Evolutionists claim Time and Chance. But who can imagine this hummer slowly revving up over a few million years waiting for the leisurely caprice of tubular framework and the faculty of flight? That would be a veritable Icarus in reverse.

In case the reader has forgotten the legend, Icarus could only escape from his prison island by building wings with feathers secured by wax. But when he soared too close to the sun, the wax melted and the feathers floated off one by one until he plunged into the sea.

Faith in the literal truth of such a story would only reveal naivete. But run that scene through the projector again only in reverse and picture those feathers coyly floating upward to rejoin wax and wing—a bit ludicrous no doubt, but no more than the poor hummingbird waiting through the millennia for some charitable Chance to waft up a few occasional fabrications or feathers.

Facetious? No more than the imagined gradual acquisition of gifts by "evolution". The only rational answer to this flying fantasy is a divine creation by a rational Creator.

Reference

Welty, Carl 1955. Twentieth century bestiary, a Scientific American book: Simon and Schuster, p. 127.

CALL FOR PAPERS

The Mid-Kansas Chapter of the Bible-Science Association will host the 4th National Creation-Science Conference in Wichita, Kansas, August 20-23, 1978.

Theme of the Conference is: "The Argument from Design—Evidences and Implications." As compared to prior conferences, increased emphasis will be given to the social sciences and humanities.

A Call for Papers to be submitted for possible presentation at the Conference is hereby issued. To be eligible for presentation at the Conference, papers should be postmarked no later than March 31, 1978.

Papers should be addressed to: Bible-Science Association Mid-Kansas Branch Chapter Attn.: Dr. Paul D. Ackerman 1429 N. Holyoke Wichita, Kansas 67208

ELECTION RESULTS

On the basis of 186 ballots cast in the annual election of Board of Director members for the Creation Research Society, the following were elected for three year terms (1977-1979):

Harold L. Armstrong Thomas G. Barnes David R. Boylan Duane T. Gish

William J. Tinkle

Emmett L. Williams

All were incumbant members of the Board of Directors, except Dean Boylan, College of Engineering, Iowa State University, Ames, Iowa.

Only ballots postmarked not later than March 1, 1977 were counted in the election. Approximately 90 per cent of the total ballots cast were received by Membership Secretary Wilbert H. Rusch, Sr. by mid-February.

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THE CATASTROPHIC DEEP-FREEZE OF THE BERESOVKA MAMMOTH

JODY DILLOW*

Received 5 October 1976

It is commonly held in historical geology that Pleistocene extinctions were a gradual process lasting over thousands or millions of years. However, frozen mammoth carcasses found buried in the tundra muck give evidence leading to a different conclusion. Of particular interest is the carcass of the Beresovka Mammoth (1901). An analysis is presented of the temperature drop necessary at the time of its death to leave the mammoth in the state of preservation in which it was found. By using thermodynamic models of the mammoth, it is demonstrated that the animal must have frozen to death in mid-summer by being suddenly overcome by an outside temperature below -150° F.

The opening remarks of Aleksandr Solzhenitsyn in his now famous *Gulag Archipelago* remind all students of natural history of one of the most perplexing mysteries of the northern tundras: the existence of thousands of frozen animal remains.

In 1949 some friends and I came upon a noteworthy news item in *Nature*, a magazine of the Academy of Science. It reported in tiny type that in the course of excavations on the Kolyma River a subterranean ice lens had been discovered which was actually a frozen stream—and in it were found frozen specimens of prehistoric fauna some tens of thousands of years old. Whether fish or salamander, these were preserved in so fresh a state, the scientific correspondent reported, that those present immediately broke open the ice encasing the specimens and devoured them with relish on the spot.¹

There is perhaps no inquiry in the whole range of Natural history more fascinating than the study of these frozen remains. Of particular interest are the mammoth carcasses found in Siberia and Alaska. Imaginations of both children and scientists are stirred when they read how barren are the inhospitable wastes of Northern Siberia. There, neither tree nor shrub will grow, and the land for hundreds of miles is covered with a damp moss barely sprinkled for two months with a few gay flowers and for the rest of the year is locked in ice and snow. There only white fox and polar bear can now survive. There, are found below the ground huge hoards of bones of elephants and other beasts whose appetites needed corresponding supplies of food.

But one's interest rises to the highest pitch when it is observed that this vast cemetery not only teems with fresh bones and beautiful tusks of ivory, but with the carcasses and mummies of these great animals. So well preserved are they in the perpetually frozen soil that the bear and wolves and even, it has been reported, men in some cases, can feed upon them. As recently as February 1976, it was reported that Russian fox trappers have frequently used manimoth meat as bait in their fox traps.² This usage has long been reported by other writers.³ Lydekker has observed:

In many instances, as is well known, entire carcasses of the mammoth have been found thus buried, with the hair, skin and flesh as fresh as in frozen New Zealand sheep in the hold of a steamer. And sleigh dogs, as well as Yakuts themselves, have often made a hearty meal on mammoth flesh thousands of years old.⁴ One of the most intriguing finds was that of the Beresovka mammoth on the Beresovka River in 1901. At this site, a perfectly preserved whole carcass was excavated 60 miles within the Arctic Circle and 2,000 miles north of the present range of living elephants.⁵

The Beresovka Mammoth

The expedition which excavated the mammoth was led by Dr. Otto F. Hertz, a zoologist on the staff of the Academy's museum, M. E. V. Pfizenmayer, a zoological preparator of the Academy's museum, and M. D. P. Sevastianov, a geological expert of Yurievsk University. The Beresovka mammoth was found frozen into a cliff of the River Beresovka, a right tributary of the River Kolym, 200 miles northeast of Srednekolymsk and 800 miles west of Behring Strait. The mammoth was located in the midst of a landslide and thus, was not found in the location where it met its death.

The excavation began on September 24th.⁶ By the time the scientists got there, the head had been exposed for over two years. Thus, much of it had been eaten by wolves and local carnivors. The mammoth originally was exposed during spring thaws when the cliff in which it was frozen began to thaw as it was washed away by spring floods. Some of it therefore, rotted and refroze during the two summers before it was examined by scientists. Well-preserved food fragments were found in the mouth and between the teeth of the mammal.⁷ This could only mean that the animal met with a sudden death and did not even have time to swallow the last meal!

The scientists built a house over the mammoth and began to thaw it out. The stench was so bad from the rotten parts that initially it was unbearable.⁸ Further indication of sudden death was found in blood which was collected in great masses due to a hemorrhage. It was found to be in such a good state of preservation that it could be examined about as easily as the blood of recent animals. It was even possible to establish the relationship of the blood to the Indian Elephant.⁹

Much decayed food was found in the stomach and the walls of the stomach were badly decayed.¹⁰ Decay of the stomach wall appeared to be due to the fact that the mammoth's back had been torn open by wild animals and the vital organs had been eaten. Thus, it had lain exposed almost to the stomach for two summers before the scientists arrived. One afternoon, the left shoulder was severed from the body and under it a startling discovery was made.

The flesh under the shoulder, fibrous and marbled with fat, is dark red and looks as fresh as wellfrozen beef or horsemeat. It looked so appetising

^{*}Jody Dillow receives his mail at 2905 Burning Tree Ln., Garland, Texas 75042.

that we wondered for some time whether we would not taste it. But no one would venture to take it into his mouth, and horseflesh was given the preference. The dogs ate whatever mammoth meat we threw to them.¹¹

Apparently while some parts of the Beresovka mammoth had rotted away during exposure to the sun, other parts not so exposed, remained as fresh as when the animals had originally died. The meat in Hertz' own words looked fresh enough to eat! Pfizenmayer added, "As soon as it thawed, however, it entirely changed its appearance. It became flabby and grey, and gave off a repulsive ammoniacal stench that pervaded everything."¹²

The flesh and fat of the right leg was also well preserved.¹³ Bits of frozen blood were found which, when heated, turned into dirty, dark red spots indicating that the oxygen content of the blood had not been fully extracted. This condition frequently indicates a sudden death. Another interesting and unexpected feature was an erect male genital.¹⁴ This condition is normally explained by a death by suffocation such as by drowning.¹⁵

As the stomach was cut open, the most amazing discovery of all was made. Inside, 24 pounds of vegetation were removed in an excellently preserved state.¹⁶ Many plants of the same type still grow in Siberia today in the summer. Others are found only far to the south, proving that the climate must have been much warmer when the mammoth lived. For example, common buttercups were found. In fact, the remains were so well preserved that it was actually possible to distinguish between species. This suggest that the stomach temperature was lowered in a relatively short time!

The animal is exhibited in the Zoological Museum of the Academy in Leningrad as a stuffed animal with the skeleton exhibited separately.¹⁷ The frozen skin has been cleaned, softened, and prepared and the animal has been actually stuffed like a modern quadruped and placed in the attitude in which it originally died. The skin of the head and ears is artificial and a model of the base of the proboscis has also been added.

Lessons to be learned from the animal are striking. At first glance it appears that a large animal was peacefully grazing on buttercup flowers and was suddenly overtaken by a deep-freeze in the middle of summer! The plant remains in the stomach of the Beresovka mammoth indicate that the animal died in late July or early August. Furthermore, the animal froze quickly enough to leave these stomach contents in a wellpreserved state and for at least some of the meat on the carcass to be edible by dogs!

The fact that it was frozen in muck is generally accepted. What is not believed by contemporary geologists is that this freezing of the mammoth was a sudden affair that was accompanied by a general sudden climatic reversal. As the writer hopes to show, one of the most direct lines of evidence of this sudden freeze is the stomach contents. The Russian scientist, V. N. Sukachev, who examined these remains, was able to identify many different species of plants, some of which no longer grow that far north, and others which grow both in Siberia today and also in Mexico!

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Circumstantial Evidence of Sudden Climate Change

There is evidence which indicated that many of the mammoths, not just the Beresovka, were frozen rapidly. For example, there are extensive reports going all the way back to ancient China of men eating mammoth meat.¹⁸ Joseph Barnes, a former correspondent with the New York Herald Tribune, testified to having been served mammoth steak at the Russian Academy of Sciences in Moscow in the 1930's.¹⁹ It is well known that ivory, to be useful for carving, must be fresh. Surprisingly, 25 percent of the mammoth ivory brought back from the tundras is as fresh as new, indicating it froze quickly.²⁰ Ezra and Cook, after a histological analysis of a mammoth bone found in Alaska, concluded that it had all the characteristics of fresh bone.²¹

Of the 39 mammoth carcasses actually examined by scientists, all were found inside the Arctic Circle, buried in the hard permafrost. The fact that these carcasses are buried in the permafrost indicates that at the time of burial, the climate must have been warm in order for the permafrost to be soft and yielding. Today permafrost only thaws down two feet in the summer.²² Yet, since the mammoths were frozen and preserved, the permafrost must have quickly frozen after the mammoths were entombed or they would have completely dissolved and rotted. Thus, their very burial in this manner testifies to a sudden temperature reversal that was also *permanent.*²³

Of great interest in this regard was the state of preservation of the stomach contents of the Beresovka mammoth (1901).

Identification of Stomach Contents

The following list of stomach contents and comments is compiled from the report by the Russian scientist Sukachev, who first examined them;²⁴ an extensive compilation of the remains by William Farrand;²⁵ a list given by Osborn,²⁶ with comments by Botanist A. A. Case of the University of Missouri.²⁷

Trees and shrubs Abies (sibirica?) Alnus hirsuta Betula alba B. nana Betula sp. Larix (sibirica?) Picea (obovata?) P. sibirica Salix polaris Salix sp. Vaccinium vitis idaea Herbs, grasses, and mosses Caryophyllaceae Cerastium sp. Dianthus sp. Melandrium sp. S. (nodosa?) Chenopodiaceae Atriplex (patulum?) Compositae Àrtemisia dracunculus Artemisia sacrorum

Artemia vulgaris Aster sp. Gnaphalium uliginosum Lactuca (Mulgedium) sibiricum Tanacetum vulgare Sp. indeterminate

Cruciferae

Sp. indeterminate

Cyperaceae

Carex glareosa Carex incurva

Carex lagopina (lachenalii?)—The remains of this sedge are numerous in the contents of the stomach. The specimens exactly resemble varieties growing today. The measurements show no reduction in size. Its range extends to the shores of the Arctic Ocean. It is found in mountainous regions, including the Carpathians, Alps, and Pyrenees. It is also found in the peat bogs of Western Prussia, in Siberia as far south as Transbaikalia and the southern island of New Zealand.28

Sp. indeterminate (N-2)

Gentianaceae

Gentiana sp.

Gramineae

Agropyron cristatum-The remains of this plant are very numerous in the contents of the stomach. They are so well preserved that there is no doubt as to the exact species. The individual specimens are slightly smaller than those of the typical more southern variety growing today, but this could be a result of some reduction of size because of pressure in the stomach, which is noted in other cases. The finding of these plants is of very great interest. Not only are they scarcely known anywhere in the Arctic regions, they are even, so far as I have been able to discover, very rare also in the Yakutsk district. . . . Generally speaking the Agropyrum cristatum L. Bess is a plant of the plains (steppes) and is widespread in the plains of Dauria.... The general range of this plant includes southern Europe (in European Russia it is adapted to the plains belt), southern Siberia, Turkestan, Djungaria, Tian-Shan, and Mongolia. Nevertheless, the variety found in the stomach differs slightly from both the European and Oriental-Siberian varieties found today.29 It is similar to the crested wheatgrass of the Great Plains and High Plains of North America.³⁰ This hardy speaks well for the thesis

This hardy speaks well for the thesis that the climate then was similar as today's.

Agrostis borealis

Alopecurus alpinus—The remains of this grass are numerous in the contents of the stomach. A significant portion of them consists of stems, with occasional remnants of leaves, usually mixed in with other vegetable remains.... All these remains are so little destroyed that one is able to establish with exactitude to what species they belong.³¹

Beckmannia cruciformis-This is common American slough grass that grows in Missouri.³² The florets of this plant are numerous in the contents of the stomach and usually are excellently preserved. The detailed description of the remains, with precise measurements in millimeters shows the species to be of the same as that of the present day, only smaller. At the present time the species is widely prevalent in Siberia and in the Arctic generally. It grows in flooded meadows or marshes.33

Bromus sibiricus

Elymus sp.

- Hordeum jubatum
- Hordeum violaccum Boiss. et. Huet—This plant is found in dry grassy areas. It is not found in the Arctic regions. In Siberia this is a meadow plant.³⁴ It is a variety of barley.³⁵ Phragmites communis

Puccinellia (Atropis?) distans

Sp. indeterminate (N-8)

Labiatae

Thymus serpyllum

Leguminosae

Caragana jubata

Oxytropis campestris

Oxytropis sordida-In the contents of the stomach were found several fragments of these beans. . . . In the fragments taken from the teeth there were found eight whole bean pods in a very good state of preservation; they even in places retained five beans.... The plant is now found in the Arctic and sub-Arctic regions, but also in the northern forests. It grows in rather dry places.³⁶ This plant is commonly known as locoweed.37

Papaveraceae

Papaver alpinum

Plantaginaceae

Plantogo media

Polygonaceae

Oxyia digyna? Rumex acetosella

Ranunculaceae

Caltha palustris

Ranunculus acris L.-This plant is known as the common tall buttercup. Some kind of buttercup may be found form the tundra in the North to near Cape Horn. Case says he has seen them in bloom under the edge of the receding snow at over 12,000 feet altitude in the Colorado Rockies in June and July.38 The plant grows in rather dry places. It is not at present found growing together with the Beckmannia Cruciformis although both are found in the stomach of the mammoth.³⁹

Rosaceae

Potentilla sp. Rosa sp. Sanguisorba officinalis Umbelliferae Aegopodium podagraria? Angelica (decurrens?) Polypodiacead sp. indeterminate (N-2) Bryophytes Aulacomnium turgidum Cladonia ragiferina Drepanocladus (Hypnum) fluitans

Several general conclusions may be drawn from these data.

(1) The presence of so many varieties that generally grow much to the south, indicates that the climate of the region was milder than that of today.

(2) The discovery of the ripe fruits of sedges, grasses, and other plants, suggests that "the mammoth died during the second half of July or the beginning of August."⁴⁰

 $(\bar{3})$ The Beresovka mammoth apparently did not feed primarily on coniferous vegetation, but mainly on meadow grasses.

(4) The mammoth must have been suddenly overwhelmed with a rapid deep freeze and instant death. The sudden death is proved by the fact that unchewed bean pods still containing the beans were found between the teeth, and the deep freeze is proven by the well-preserved state of the stomach contents.

State of Preservation of Stomach Contents

When the above list of stomach remains was presented to professional botanists, Dr. Mahler and Barney Lipscomb at the Southern Methodist University Herbarium, their reaction was one of amazement. It seemed incredible to them that the remains could have been so well preserved that different species could be distinguished. The reason for their amazement was the presence of digestive juices which quickly act to break down the vegetable material of the delicate parts of the plants which are necessary for identification. Since the elephant is not a ruminant⁴¹ (i.e., multi-chambered stomach), acid deterioration and enzyme activity would be major factors in breaking down the "cement" which holds the cellulose together in the plant fiber. Since mechanical action of the stomach would break up all vegetable matter within one half hour, the animal must have died within one half hour of swallowing this food.42

According to the Dallas Coroner, acid and enzyme action would completely dissolve the delicate parts of these plants within a matter of hours. He said he would be "shocked" to see them in recognizable form a day after the death of the animal. Dr. C. W. Foley, a Veterinary Physiologist with the University of Missouri Medical School, was asked how long the buttercups might last in the stomach of the mammoth after death, and he responded, "I wouldn't think they would last more than a couple (2-3) hours, maybe more in a ruminant."⁴³

As a final check on these estimates, an experiment was conducted with the aid of Dr. Larry Bruce, a gastro-intestinal physiologist with the University of Texas Health Science Center at Dallas. First, a solution of stomach acid was prepared by mixing 70 micromoles of swine pepsin with a 0.1 normal solution of HC1 with a PH of 1 (250 mg of pepsin per 100 ml HC1). To this solution a small amount of NaCl (0.9%) was added as a catalyst. This solution was then poured into four different beakers, each at a different temperature: 4 °C, 17 °C, 27 °C, and 37 °C. After the temperatures had been established, some gladiolas and carnations were compacted into the beakers so that the surface level of the solution corresponded to the top of the flower compaction. The stems, leaves, and flowers were all included.

On the assumption that it was necessary to have delicate parts of these plants in order to identify them at the species level, these four solutions were left to act on the flowers until the flowers were in each case beyond recognition. Although the observation of this process proved to be highly subjective, four categories of decay were oberved:

A = first appearance of dye from the flowers in the solution;

B = the beginning of a loss of flower structure;

C = structural support completely gone, flower petal dissolved beyond recognition; and

D = leaching of flower petal pigment.

Results are reported in Table 1.

It would appear that the gladiola could not have lasted more than five hours in the stomach of a mammoth, even if the initial temperature of the mammoth was 4 °C (40 °F). The gladiola and the buttercup are both considered very delicate plants, and thus, the buttercup's longevity in a mammoth's stomach is severly limited! The carnations, however, lasted considerably longer. At the end of 10 hours in the 4 °C beaker, the carnations had hardly been touched, whereas they were beyond recognition in the 17 °C beaker in 25 hours.

Since it is not known for sure what the resistance to attack by acid and enzymens may have been in ancient buttercups, it is risky to draw precise conclusions. However, the above experiment certainly suggests some limits of perhaps 10 hours for flower longevity if the stomach temperature was initially at 37 °C.

If the buttercup had the resistance of a carnation, the stomach temperature would have had to have been lowered to 40 °F within 10 hours to have left anything in recognizable form. This is probably a maximum because the above experiment did not take into effect the chewing of the food by the mammoth, nor did it account for the continued mechanical activity of the stomach which persisted for up to $\frac{1}{2}$ hour after death.⁴⁴ Both of these factors would have acted on the stems and leaves, and with great effect on the flower petals.

In view of the uncertainties involved and the omission of chewing and mechanical action after death, it seems that a reduction of the stomach temperature to 40 °F within 10 hours would be the outside limit of buttercup longevity. This would correlate fairly well also with the requirements for finding any edible meat on a mammoth which apparently has, in some cases, happened.

The only way there could have been any recognizable remains in the stomach of the mammoth would be through cessation of the digestive activity. The only mechanism that will do this is cooling. The reduction in enzyme activity follows van't Hoff's rule which says

Table 1. Progressive decay of gladiolia flower petals in a solution of stomach juice at various temperatures. See the text for the significance of A, B, C, and D.

	4°C	17°C	27°C	37°C
A	3	11/2	1	1
В	4	3	3	2
С	5	31/2	31/2	3
D	_	25	10	10

that for every 10 °C decrease in temperature, enzyme activity is reduced by 50%. When a professor of veterinary physiology, Dr. C. W. Foley, was asked, "Is there any other way than a sudden freezing that these buttercups could have survived in such a well-preserved form?", he replied, "I can't think of any other way." Botanist A. A. Case, after examing the list of the remains concluded,

If the mammoths and other animals were "quick frozen" in their tracks by minus 100-degree C type of climatic upheaval as suggested by some, the things found today would be logical.⁴⁵

The acute nature of this problem has been overlooked consistently by the theorists of mammoth extinction. The plants in the stomach only blossom when the weather is warm (buttercups will not even grow unless the temperature is well above 40 °F.), and yet, shortly after ingestion, the temperature must have dropped sufficiently to reduce the stomach temperature of the mammoth to at least 40 °F within 10 hours! Clearly a drastic climatic upheavel is required and there appears to be no escape from this conclusion!

The necessity of this sudden temperature drop is seen to be inescapable when the precise state of preservation of these remains is considered. While some parts of plants are especially resistant to acidic and enzyme decay, the parts necessary to draw distinctions between species are quite soft and sensitive. For example, Sukachev drew distinctions between different species of Carex. Yet,

In order to be certain of one's identification in this group, the largest genus encountered in Missouri, it is necessary to have fully mature pistillate flowers with well-developed achenes, and a complete specimen with roots and all.⁴⁶

The flowers are, of course, very delicate, and would be dissolved quickly by acidic action and enzyme activity. The achene is the fruit of the plant. It is surrounded by the perigynium or "sack". The presence or absence of this delicate sack is one factor in distinguishing between various species of Carex.⁴⁷ The achene is only 0.3 to 0.6 mm long. Yet this very small part of the plant with its delicate covering was preserved through the acid bath in the stomach of a dead mammoth.

In the case of the buttercups, a similar situation exists. The achenes alone are not sufficient to identify which species of buttercup are present, because many of them are about the same size. The particular genus of buttercup is determined by the color of the leaves, dark blue or purple.⁴⁸ Thus, the buttercup flowers were preserved in the stomach of the mammoth and in such a state that it was possible to distinguish between two such similar colors as dark blue and purple! To determine the species of buttercup, i.e., *Ranunculus acris*, an examin-

ation of the fleshly parts, the sepals (a modified leaf of a flower), and the color of the petals is necessary.⁴⁹ All of this requires that the stomach temperature of the mammoth was dropped very quickly, or there would be none of these delicate parts in identifiable form.

Sudden Deep Freeze of Beresovka Mammoth

It should be evident from the above discussion that one is faced with a situation most foreign to uniformitarian geology. The stomach contents indicate that it was mid-summer when the mammoth died, and yet, the state of preservation of the stomach remains require that shortly after death, the stomach temperature must have been lowered to temperatures in the 30's F. in order to stop the activity of the digestive juices. The question now is: what degree of outside temperature drop is necessary to reduce the stomach temperature to around 40 °F. in ten hours? In consultation with Dr. Roger Simpson of the Department of Civil and Mechanical Engineering at Southern Methodist University, two thermodynamic models of the mammoth were constructed.

The Thermophysical Properties of Mammoth Meat

In order to set up a physical model from which the above question may be answered, certain assumptions must be made concerning thermophysical properties of the mammoth. Since this specific information is impossible to obtain, it will be assumed that these thermodynamic properties were similar to those of contemporary elephants and that the thermal properties of the meat are not much different from those in beef, which are fairly well known.

For the calculations below, four properties must first be determined: (1) thermal conductivity of beef, (2) specific heat of meat (3) density of the mammoth, and (4) film conductance of the mammoth.

(1) Thermal conductivity of beef. This quantity, k, is a measure of the time rate of transfer of heat by conduction, through a unit of thickness, across unit area for unit difference of temperature.⁵⁰ The dimensional units are BTU per hour per foot per F° in the British Engineering System, which is used here. This property of the meat would vary with the temperature of the animal. A value of 0.257 BTU/hr-ft.-°F. for a temperature range of 100 °F. to 32 °F. will be assumed.⁵¹

(2) Specific heat of beef. This quantity, c, is a measure of the amount of heat necessary to raise the temperature of a unit mass of a substance one degree F. The dimensional units are BTU per pound per degree F. Like thermal conductivity, specific heat varies with temperature. In the temperature range of 100 °F. to 32 °F. a value of C = 0.84 BTU/lb- °F. is used.⁵²

(3) Density of beef. It will be assumed that the density of the mammoth, i.e., the mean or average density, is about the same as that of a human being or a cow today. The mean density of a cow has been computed to be 66.14 lb/cu. ft.⁵³

(4) The film conductance of the mammoth. This quantity, h, is the coefficient of heat transfer between a surface and its surroundings. It is a measure of the energy dissipated from a unit area of a surface per unit

time for unit difference of temperature between the surface in question and surrounding bodies. The units are BTU per hour per ft.² per °F. For forced convection heat transfer produced by a cold wind, this coefficient is dependent upon the geometry of the freezing specimen and other factors including the kinematic viscosity and the wind velocity. For modeling purposes, the mam-moth will first be approximated by a cylinder. The formula for the film conductance for flow over a cylinder is then,⁵⁴ $h = (C) (Re)^m (k/d)$ where C = 0.024 and m= 0.8, (constants for a cylinder).⁵⁵ The diameter, d, of the mammoth will be assumed to be 5 ft. This value was suggested to the Birds Eye engineers by a curator of the American Museum of Natural History.⁵⁶ The thermal conductivity, k, of air is 0.015 BTU/ft-hr-°F. (at 0 degress C).⁵⁷ The equation for the Reynolds number, Re, is given by⁵⁸ Re = (wind velocity)(diameter)/ (kinematic viscosity). The kinematic viscosity is the ratio of the dynamic viscosity $(1.11 \times 10^{-5}]b/ft-sec.$ for air at 0 °C), to the density (0.086 lb/ft.3 for air at 0 °C) or 1.25×10^{-4} ft.²/sec.⁵⁹ If the cold wind that overcame the mammoths moved across the tundras at 100 mph (147 ft./sec.), the Reynolds number would then be 5.68 \times 10⁶. This gives a value of h = 18.24 BTU/hr.-ft.²-°F.

In 1961 Birds Eye, experienced with frozen meat, was asked to check the credibility of an article on the mammoths to be published by *Reader's Digest*. The Birds Eye engineer, Ivor Morgan, who did the calculations, assumed a wind velocity of 40 mph and a temperature of -50 °F. and a value of h = 10.5 BTU/hr-ft.²-F. In the calculations below, a value of 18.24 will be assumed.⁶⁰

With these approximate assumptions, it is possible to predict with fair certainty the magnitude of the outside (ambient) temperature necessary to have left the Beresovka mammoth in the state of preservation it was found. Two different geometries will be used for a physical model of the mammoth: an infinite cylinder, and an equivalent sphere.

Model #1: An Infinite Cylinder

The Birds Eye engineers originally modeled the mammoth as an infinite cylinder. Luikov has presented graphical solutions for the problem of the rate of cooling of an infinite cylinder that render tremendously complex calculations relatively simple.⁶¹

Figure 1 shows $\theta = (T - Ta)/(Ti - Ta)$ as a function of Fourier number. T is the temperature of a certain point in the cylinder, in this case 40° F. at six inches into the mammoth. It is assumed that if the temperature of a point six inches into the mammoth has been brought to 40 °F., that digestive action will have been sufficiently retarded so that the mammoth could freeze over the next few weeks without significant further digestive damage to the stomach contents. Needless to say, this is a very generous assumption. The stomach begins at about six inches into the mammoth.⁶² Ta is the ambient temperature of the surrounding air; a value of -50 °F. (a more moderate value consistent with today's observations) and values - 100 to - 250 will be used (radical values beyond present day experience). Ti is the initial temperature of the mammoth. It will be assumed that the mammoth was suddenly overcome by intense cold

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Figure 1. This is a plot of the dimensionless excess temperature $(1 - \theta)$ vs. the Fourier number for various values of the coordinate for a cylinder.

so that he immediately stopped whatever he was doing (including chewing), and began slowly to freeze to death. Death will occur at 74 °F. in a mammal.⁸³ Thus, at -50 °F., $(1 - \theta) = 0.274$ and at -175 °F., $(1 - \theta) = 0.137$; and at -200 °F., $(1 - \theta) = 0.124$.

The ratio, r/R is the ratio of the distance a point r'' is from the center of the mammoth to the radius of the mammoth. In this problem a value for r = (30'' - 6'') = 24'' is assumed. Thus r/R = 0.8.

The dimensionless Fourier number is given by, $Fo = at/R^2$ where a = k/(den)(c). From the above discussion of the thermophysical properties of mammoth meat, a value of k = 0.257 BTU/hr-ft.²-°F., den. = 66.14 lb/ft.³, and c = 0.84 produce a = 0.00462 ft.²/hr. In the above, t =time in hours, and R = the radius of the mammoth in feet = 2.5.

By reference to Figure 1 it can be seen, therefore, that when Ta = -50 °F., that the Fourier number is 0.274 and t = 19.6 hours. If Ta = -175 °F., then the Fourier number is 0.137 and t = 10.8 hours. Due to the fact that the outer few inches of the mammoth will plunge way below freezing in the first few minutes, the rate of heat removal will be somewhat faster than the above calculations allow for. This is because the thermal conductivity of the outer shell will increase threefold with the sudden freezing of the outer shell while the specific heat will drop by nearly 30%. Thus, it may be safely concluded that if the outside temperature is dropped suddenly to -175 °F., that a point six inches into the mammoth would be brought down to 40 °F within 10 hours.

Assuming the above parameters, the time necessary to bring a point six inches into the cylinder down to 40 °F. is displayed in the Table 2 (graphical solution). If the temperature was similar to observed temperatures today, (i.e., -50 °F.), the digestive bath would have nearly 19 hours to dissolve the stomach contents and there would be nothing left well enough preserved to distinguish the species. This calculation indicates that the mammoth must have been overcome suddenly by temperatures approaching -175 °F.!

	Graphical Solution (Cylindrical geometry)				
Air temp. Ta, °F.	Time, bring me of mam 40	hr., to an temp. moth to °F.	Time, hr., to bring a pt. 6″ in to 40°F.		
	Ti = 100	Ti = 74	Ti = 100	Ti = 74	$Ti = 74^{\circ}F.$
- 50	45.0	25.0	33.0	25.0	19.6
- 100	20.0	12.8	20.0	15.0	14.2
-129	16.3	11.0	17.5	13.3	13.5
-150	13.0	9.5	15.2	12.0	11.9
-175	11.6	7.6	14.2	10.1	10.8
- 200	10.0	6.5	12.8	9.0	10.4
-225	8.3	6.5	11.4	8.8	9.9
- 250	7.8	5.3	10.8	7.8	9.6

Table 2. Time in hours to bring the temperature of the contents of the stomach down to 40°F, for various external temperatures of the air.

Model #2: An Equivalent Sphere

In order to validate the above equation, an inquiry was directed to the Birds Eye Frozen Food Corporation in New York. In a popular science article it had been reported that:

Birds Eye frozen food experts, in examining the mammoth tissue, have deduced that they were "thrown into the cooler" suddenly, into temperatures below -150 °F.⁶⁴

The writer contacted the Birds Eye engineer, Ivor Morgan, who did the calculations on the mammoth in February of 1960. Apparently, Birds Eye had been asked by *Reader's Digest* to check the credibility of an article they were proposing to publish in 1960 on the catastrophic deep freeze of mammoths. They did not, as was erroneously reported, "examine mammoth tissue."⁶⁵

However, Mr. Morgan supplied the writer with a computer program which he designed for Birds Eye to determine freezing rates in spheres of different diameters.⁶⁶ This program was quite rigorous and took into consideration the precise variation of specific heat and thermal conductivity with temperature, and also considered the effects of freezing and the extraction of the latent heat of fusion. In order to adapt the program specifically to the mammoth question, a computer programmer, Bert Dollahite, who works with the U.S. Army in Washington, D.C., was consulted.

The program assumed the mammoth to be composed of ten concentric spheres. It is really an approximate solution of the Fourier heat conduction equation for small increments of time and small finite increments of spherical radius. Heat flow into each of the ten concentric spheres, less heat flow out, equals the residual heat which manifests itself as a change of state and temperature. The program has the ability to compute the mean or average temperature of the mammoth at any given time as a function of the outside temperature. Mr. Morgan who designed the program and Mr. Dollabite who adapted it, said that the mean temperature would give an accurate representation of the temperature of the stomach contents of the mammoth at any given time.

In order to determine the equivalent volume of the sphere, an approximation of the size of the main body of the mammoth was made. Based on the suggestion made to Birds Eye by a curator of the American Museum of Natural History, the radius of the mammoth was set at 2.5 ft. The length of the main body was estimated to be about eight feet.⁶⁷ Thus, the mammoth's torso is modeled as a cylinder, eight feet long and five feet in diameter. The volume of such a cylinder is 271,296 cubic inches; and the radius of a sphere of the same volume is 40 inches. Thus, in the program, a sphere with a radius of 40 inches is equivalent to the mammoth carcass. The assumed film conductance is the same as that of the cylinder, 18.24, and the density is 66.14 lb/ft.³. With these parameters, the Birds Eye program yields the data for the time necessary to bring the mean temperature of the mammoth to 40 °F., as a function of the ambient temperature, given in Table. 2.

From Table 2 it can be seen that the Birds Eye program and the Luikov graphical solution for a cylinder show general agreement for somewhat different assumptions on the geometry. It is obvious from Table 2 that temperatures well below -150 °F are necessary in order to bring the temperature of the stomach contents down to the required 40 °F. within the 10-hour limit specified by the botanists and gastro-intestinal physiologists consulted.

It is interesting to note that this temperature (-150 °F) was the same as that reported by Ivan Sanderson. Referring to a report that indicated the cells of the mammoth had not burst, Sanderson argued⁶⁸ that frozen food experts concluded that the mammoth under examination had been frozen at temperatures below -150 °f. Thus, the same figure was determined from two entirely different approaches!

To say that 10 hours is the limit and 40 °F. the required temperature is probably a conservative estimate. It is more likely that the temperature had to be brought to 35 °F. within six or seven hours. Furthermore, if the Beresovka mammoth was killed instantly, as the evidence could indicate, then Ti = 100 °F., and air tempertures of below -200 °F. would have been necessary. The value of Ti = 74 °F. assumes that the animal gradually froze to death.

In the computer solution, the reason that the mean temperature closely approximates the temperature of a point 7.27 inches into the mammoth is that about 42.6% of the volume of the mammoth is outside of a point 7.27 inches from the surface. The temperature outside that point is much lower, and almost half of the volume of the mammoth is located there.

It should be emphasized that the above calculations are based on the premise that rapid cooling was necessary to preserve the plant remains. However, even if it were possible to have identified these plants without reference to their vegetable parts, the fact that edible meat has been carved off of mammoth carcasses requires a similar temperature drop to 40 °F. within ten hours to have left meat edible

Conclusion

It is clear that for the Beresovka mammoth, some violent climatic upheaval is the only explanation for these remains. The animal was peacefully grazing on summer buttercups in late July and within one half hour of ingestion of his last lunch, he was overcome by temperatures in excess of -150 °F. He was killed soon after and frozen to death in the middle of the summer. Furthermore, he never completely thawed out *until* he fell out of a riverbank in 1901. Thus, whatever climatic upheaval caught him, permanently changed the climatic conditions of the tundra. Certainly, here is clear evidence of the sudden deep-freeze posited by so many students of the mammoth question for the past two centuries.

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RAPID GROWTH OF DRIPSTONE OBSERVED

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Evolutionists generally assume that dripstone deposits, such as stalactites and stalagmites, form slowly, while creationists would maintain that rapid rates of formation must be possible. Here factors affecting the rate of formation of dripstone are discussed. Hypothetical environmental conditions immediately following the Genesis flood would be expected to produce rapid formation of dripstone. Actual observations of rapid formation are reported. Therefore, the creationist position is supported by theoretical as well as experimental data relating to the rate of formation of dripstone.

Introduction

Creationists assume that limestone caverns were formed several thousand years ago, during or immediately following the Genesis flood. The generally accepted phreatic (below the water table) theory of cave formation¹⁻⁵ is in agreement with the Genesis account of a world-wide flood and therefore supports this assumption. Caves may have formed rapidly during the flood (after the major sedimentary deposits had been laid down) or immediately following the flood. As the continents were raised, declining water tables would have drained the caves and produced conditions suitable for growth of dripstone. The present existence of large stalactites and stalagmites would therefore demand recent environmental conditions suitable for *rapid* formation of dripstone.

Evolutionists, on the other hand, generally assume that dripstone has always formed *extremely slowly* under the environmental conditions found in caves.⁶ Consequently, large stalactites and stalagmites, and the caves containing them, are often considered to be hundreds of thousands to millions of years old.⁷

Data concerning the actual growth rates of stalactites and stalagmites under various environmental conditions should be of interest therefore, to creationists and evolutionists alike.

Since this type of research project was suggested⁸ in 1970, several brief articles have appeared in the creationist literature which suggest that stalactite growth can and does occur rapidly.^{5,9-11} It is the purpose of this communication to discuss the factors which may have affected the rate of stalactite and stalagmite growth since the Genesis flood, and to report actual observations of rapid dripstone deposition.

Factors Affecting Stalactite and Stalagmite Growth

Water containing carbon dioxide is weakly acidic and reacts with calcium carbonate (calcite) in limestone to produce soluble calcium bicarbonate (reaction a) as it percolates into the ground. When the water reaches the ceiling of a cavern, evaporation and loss of carbon dioxide may reverse the reaction and cause precipitation of calcium carbonate in the form of a stalactite or stalagmite (reaction b).

$$CaCO_3 + H_2O + CO_2 \xrightarrow{a} Ca^{++} + 2HCO_3^{-}$$

Several factors have been identified which affect the rate and manner of deposition of calcium carbonate as stalactites and stalagmites. These include: 1) the concentration of calcium bicarbonate in the solution 2) the drip rate and 3) the rate of evaporation (including loss of carbon dioxide) which is controlled by the air circulation, temperature, and humidity.¹²

Thus, a high calcium bicarbonate concentration (over 50 percent), slow drip rate (less than 1 drip per second), and rapid evaporation favor rapid vertical growth of a small diameter stalactite (Table I, A). Similar concentration and drip rate but with slow evaporation results in slow formation of a large diameter stalactite (Table I, B). High calcium bicarbonate concentration, rapid drip rate, and rapid evaporation favor rapid vertical growth of a small diameter stalagmite (Table I, C). Similar concentration and drip rate combined with slow evaporation, produces slow formation of a large diameter stalagmite (Table I, D). Finally, lower concentrations of calcium bicarbonate result in slower vertical growth rates for both stalactites and stalagmites, the effect being more pronounced for stalactites.¹³

Of these factors, the rate of deposition of calcium carbonate is usually determined by the *rate of evaporation* and the *concentration* of calcium bicarbonate. (Drip rate determines primarily whether a stalactite or stalagmite will be formed.) Since the rate of evaporation is controlled by three variables (air circulation,

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 Table 1. Effect of Environmental Conditions on Dripstone Formation.

	Concen- tration	Drip	Evapo- ration	Results in:
A.	High	Slow	Rapid	Rapid vertical growth of small diameter stalactite
B.	High	Slow	Slow	Slow formation of a large diameter stalactite
C.	High	Rapid	Rapid	Rapid vertical growth of a small diameter stalagmite
D.	High	Rapid	Slow	Slow formation of a large diameter stalagmite

temperature, and humidity), it is difficult to determine what effect, if any, the changing environmental conditions following the Genesis flood would have had on the rate of evaporation in caves and thus, on the rate of deposition. However, the rate of deposition could have *decreased* significantly due to the reduction in calcium bicarbonate concentration produced by one or more of the following factors.

The concentration of calcium bicarbonate present in solution at equilibrium is determined primarily by the concentration of dissolved carbon dioxide.^{14,15} The concentration of carbon dioxide in *surface* water is controlled by the water temperature and partial pressure of carbon dioxide in the atmosphere. Although these factors may have changed somewhat since the flood, it is unlikely that they would be major factors producing changes in the carbon dioxide content of *vadose* (between the land surface and the water table) water.

The amount of carbon dioxide produced by *bacterial decay of organic material* may be much more significant. Since surface water absorbs additional carbon dioxide as well as humic acid produced by bacteria in the soil, as it trickles into the ground,^{16,17} the concentration of bicarbonate in *vadose* water would be strongly dependent on the concentration of decaying organic material in the upper sedimentary strata. That these strata were once rich in organic material which has since decomposed is apparent from the wealth of fossils remaining. Thus, the concentration of calcium bicarbonate arriving at the ceiling of a cave would be expected to decrease with time due to decreasing concentrations of organic material remaining in the sedimentary strata above the cave.¹⁸

Limestone above a cave would also be expected to decrease in *solubility* with time due to the spontaneous diagenesis (aging) process. The decrease in solubility of precipitates due to aging is a well-known phenomenon to analytical chemists. Furthermore, *diagenesis is known to occur in limestone* as a result of pressure and presence of water.¹⁹ It has been cited to account for the more rapid vertical growth of stalactites on young concrete (less than one year old) relative to stalactites on older concrete (three to 11 years old) under similar conditions of evaporation.²⁰ Thus, the concentration of calcium bicarbonate arriving at the ceiling of a cave would also be expected to decrease with time due to the decreasing solubility of limestone above the cave.

Limestone is generally crisscrossed with fractures produced by geological stresses.²¹ Diagenesis may also produce enlargement of the fractures due to the shrinkage of the limestone.²² These fractures would be further enlarged due to solution of calcium carbonate from the walls of the openings.^{23–25} Enlarged fractures would allow vadose water to penetrate the limestone more rapidly, again reducing the calcium bicarbonate concentration at the ceiling of a cave because of the reduced contact time between the solvent and solute.

Consequently, vadose water percolating through newly consolidated limestone strata soon after the flood would have possessed a higher concentration of calcium bicarbonate upon reaching the ceiling of a cave than is usually observed today. Since the rate of growth of dripstone formations in the cave is directly proportional to the concentration of calcium bicarbonate in the solution, more rapid growth rates would have occurred in the years immediately following the flood than are generally found today.

Observations of Rapid Stalactite Growth

In April, 1976, numerous stalactites were observed under concrete bridge Number CLA42-0012 (Figure 1) on U.S. 42 approximately five miles east of Cedarville, Ohio. According to construction records,²⁶ the bridge was built in 1941. Thus, the stalactites measuring up to 150 mm in length and 13 mm in diameter (Figure 2) with approximately a 3 mm diameter capillary, have grown in 35 years or less. The minimum average growth rate is therefore 4.3 mm per year.

Since the road surfaces of bridges in this part of Ohio are sealed to reduce penetration and thus erosion by rain water, and since stalactite growth under bridges can only occur during wet weather, this minimum average growth rate is indeed surprising. (See Table 2 for information about the weather.) It is an order of magnitude greater than that reported for stalactites on the spillway ceilings of a dam.²⁷ Furthermore, the minimum volume of deposition, approximately 0.53 cm³ per year, is the same order of magnitude as the 0.83

Table 2. Weather conditions at Cincinnati and Columbus, Ohio, which are thus typical of those prevailing where the investigations reported here were carried out. These data are from Conway, H. McKinley, Jr. ed., 1963. The weather handbook. Conway Publications, Inc., Atlanta, Georgia, and World Weather Records, 1951-1960, Vol. 1, North America, U.S. Department of Commerce, Washington, D. C., 1965.

	Cincinnati	Columbus
Average number of days of rain (0.01 inch) per year	132	135
Average number of days of snow (1 inch) per year	8	8
Mean annual precipitation (mm)	1004	857
Average wind velocity (mph)	$7 \mathrm{sw}$	8ssw
Mean annual temperature (°C)	12.9	12.1
Average relative humidity (%)	57	58
Percent possible sunshine	57	55



Figure 1. Bridge CLA42-0012 on U.S. 42 near Cedarville, Ohio.



Figure 2. May 22, 1976. The largest stalactite was 150 mm in length.

cm³ per year reported for continuous deposition of calcium carbonate using simulated rain water in a laboratory situation.²⁸ Finally, it is considerably larger than the average rate of deposition of dripstone of 0.164 cm³ per year (1 in³ per hundred years) sometimes mentioned in the geological literature.²⁹

The actual growth rates of the stalactites under this bridge may vary considerably during the year, depending upon the temperature, humidity, wind velocity, and rain fall. Between May 22 and October 2, 1976 (19 weeks), the stalactite mentioned above increased in length by 10 mm (Figure 3)! Such rapid growth was completely unexpected! Yet, other stalactites under the same bridge appear to have grown even more rapidly though quantitative data are not yet available. Therefore, it must be emphasized that the minimum average growth rate of 4.3 mm per year is indeed a *minimum*. *Actual* rates of growth may easily be as much as an or-



Figure 3. October 2, 1976. This stalactite grew 10 mm in length in only 19 weeks.



Figure 4. Flowstone up to 1 cm thick.

der of magnitude greater than this minimum under ordinary environmental conditions.

On September 23, 1976, several white circular calcium carbonate deposits 4 to 5 cm in diameter were also observed on the bare ground under the bridge. They had not been noticed in the spring, and therefore, must have formed during the summer months. They were located directly under growing stalactites where water dripped from the bridge to the ground, and thus appeared to be premature stalagmite deposits. Therefore, stalagmites might be expected to form very rapidly at these locations. Absence of stalagmites several centimeters in length is undoubtedly due to annual erosion and redeposition of soil under the bridge when the creek rises during the wet spring weather.

Finally, deposition of flowstone (a deposit formed by flowing rather than dripping water) has been reported to be even slower than deposition of dripstone.³⁰ Yet

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flowstone deposits up to approximately 1 cm thick on the concrete supporting walls of this bridge (Figure 4) attest to the reality of relatively rapid flowstone deposition as well.

Such rapid rates of deposition of calcium carbonate are not limited to this particular bridge or location. Since April, 1976, stalactites have been observed under two other concrete bridges in this same area as well as under a bridge in Grand Rapids, Michigan. They have also been mentioned in the creationist literature by others.31 Thus, minimum average growth rates measured in millimeters per year for stalactites under concrete bridges appear to be relatively common.

However, environmental conditions under *bridges* are considerably different from those in *caves*. Thus, it could readily be argued that these growth rates do not apply to stalactites in caves. Conditions in *mines*, however, might be expected more closely to resemble those found in caves. But a study of stalactite and stalagmite growth conducted at the Experimental Mine of the United States Bureau of Mines near Bruceton, Pennsylvania, revealed even larger growth rates. Growth rates of stalactites on the concrete roof of the mine range from 12 mm per year to 173 mm per year.32 These are from 3 to 40 times the minimum average growth rate observed under the concrete bridge! Obviously the environmental conditions in this mine are even more, rather than less, conducive to rapid stalactite growth than those under the bridge.

Finally, an effort was made to obtain evidence of rapid deposition of calcium carbonate under authentic cavern conditions. A survey of the Olentangy Indian Caverns,33 just off U.S. 23, north of Columbus, Ohio, revealed that the electrical wiring is encrusted with 1 to 2 mm of flowstone in several locations, and in one instance at least, is actually cemented to the wall of the cave by the deposits. Much of the original wiring, installed in 1935, has been replaced in more recent years. Since maintenance records concerning the wiring have not been kept, the exact age of the encrusted wiring is uncertain, but it cannot be more than 41 years old. Obviously, deposition of calcium carbonate can occur at measurable rates even under the environmental conditions found in caves today.

Furthermore, the large stalagmite known as Crystal Spring Dome in Carlsbad Caverns has been reported to be growing as fast as 2.5 in³ (41.0 cm³) per year "... in spite of the present dry New Mexico desert above!"³⁴ At this rate, a 10,000 in³ stalagmite which would require 1 million years for formation at an average deposition rate of 1 in³ per hundred years could actually be formed in only 4000 years! When the possibility of even greater growth rates in the recent history of the Earth are considered, it becomes apparent that even the largest known dripstone formations could have formed in only a few thousand years. Therefore, it is clearly unnecessary to postulate that large stalactites and stalagmites have required hundreds of thousands of years for their formation.

Conclusions

Dripstone growth rates in caves are directly proportional to the concentration of calcium bicarbonate in

vadose water. The concentration of calcium bicarbonate is dependent on the concentration of dissolved carbon dioxide, the solubility of the limestone through which the solution passes, and the contact time between the solution and the limestone. Thus, increased amounts of carbon dioxide in the soil, existence of the limestone strata in a more soluble state, and longer contact time between the solution and the limestone immediately following the Genesis flood would have provided ideal conditions for rapid dripstone growth in caves.

Rapid calcium carbonate deposition has actually been observed under concrete bridges as well as in a cave in the Midwest. Furthermore, rapid growth rates for stalactites on the concrete ceiling of a mine and for stalagmites under actual cavern conditions are known. Therefore, it is concluded that dripstone formations do not always grow slowly. Under appropriate conditions, they may form very rapidly, even in caves. Consequently, it is not necessary to accept the evolutionary postulate that caves have existed for long periods of time in order to allow for the slow growth of stalactites and stalagmites. Instead, the creationist theory involving recent cave origin and rapid dripstone growth is a viable alternative which is in agreement with experimental data concerning dripstone growth rates.

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THE ROTATION-CURVE OF THE VIRGO CLUSTER OF GALAXIES

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The rotation-curve for the Virgo cluster of galaxies and the so-called Southern extension is presented. The two appear distinct in their radial velocity distributions and, in addition, there appears to be another grouping associated with NGC 4261. The masses of the two clusters are $(1.3 \pm 0.2) \times 10^{15}$ and $(1.6 \pm 0.2) \times 10^{14}$ solar masses respectively. The central densities are $(3.5 \pm 1.0) \times 10^{-25}$ and $(2.6 \pm 0.5) \times 10^{-26}$ gm cm⁻³ respectively. Boundary conditions yield an estimate for the intercluster medium of the supercluster of $(2.2 \pm 0.8) \times 10^{-29}$ gm cm⁻³. The period of revolution of the two clusters about each other is about 3.4×10^{11} years; more than ten Hubble ages. This latter factor and the discovery of a previously unsuspected shell wherein the number of direct and retrograde moving galaxies are equal provide further damaging evidence against the prevailing modern cosmogony.

Introduction

The study of rotation-curves is fundamental to galactic dynamics. This report presents a study of evidence that clusters of galaxies are rotating and that they are stable on "time scales" some ten times greater than the presently held age of the cosmos.

Everyone is familiar with the idea of putting men and satellites into orbit about the earth, moon or other planets. Such behavior is held possible because the gravitational force can be balanced by the centrifugal force. The former tends to draw bodies together while the latter acts in such a way as to draw them apart. In the same way the planets revolve about the sun. It is also observed that stars may go around each other, as is the case for double stars.

The stars, in turn, are organized into larger bodies called galaxies which also appear to be held together gravitationally in the same way as is true for the solar system. Galaxies, in turn, can also be double or multiple and can also be grouped into ensembles called galaxy clusters. Evidence is presented here to show that these clusters are also held together by gravitation, and that they, too, rotate as a whole in just the same manner as the solar system. Now the gravitational attraction of bodies depends upon their masses and hence it is possible, for example, to deduce something about the mass of the sun from the motion of the planets. Similarly, something can be found out about the masses of double stars; likewise for galaxies and, by extension of the idea, the clusters of galaxies.

Of course, the motion of galaxies cannot be observed directly as that of the planets can. It can, however, be deduced from the Doppler effect, the phenomenon which lowers the pitch of a passing automobile horn. Instead of sound, of course, in the case of stars and galaxies one is dealing with a shift in the color of the object's light as it moves toward or away from the observer.

Simply stated, a rotation-curve is a plot of the rotational velocity against the central distance. To arrive at a rotation-curve for the solar system, for example, one would plot the orbital speed against the distance from the sun. This approach is not very practical nor necessary for the solar system where there are only a few objects which can easily be dealt with separately; but in the case of a galaxy with some 10¹¹ objects it is quite practical.

The same is true for galaxy clusters, although they contain only a few hundred member galaxies. Part of the reason is that at present an observer can only estimate the motions of a few stars and no galaxies perpendicular to the line of sight (i.e. in what direction

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and how fast in the plane of the sky). To date, only rotation-curves for galaxies have been attempted; and about 100 have appeared in the literature.

There are three basic properties which can be deduced from a rotation-curve. These are: (1) the density as a function of radial distance, $\rho(r)$; (2) the total mass interior to a distance r, M(r); and (3) the surface mass distribution, which will not be discussed here.

Certain assumptions are necessary. These include circular motion of the velocity average in a given locale (i.e. local centroid), and some assumptions about the over-all shape of the object (a spheroid). Newtonian gravitational formalism is also assumed.

Historical Development

To date rotation-curves have only been attempted for galaxies. The first was done by Fritz Zwicky¹ in 1933 and since then there has been a gradual refinement of technique and theory. In 1942 Chandrasekhar² derived an analytic expression for the rotation-curve of the Galaxy; but it has not proven to be general enough to fit all galaxies. About that time' problems appeared with negative densities at large distance from the dynamic center and to date no satisfactory resolution of that phenomenon has been proposed. Later models have managed to circumvent the negative densities; but there seems to be a certain point beyond which the mass interior to r starts to decrease as r increases. More on this later in the section on mass.

The development of the most popular model to date started in 1959 in a paper⁴ which noted that the square of the circular velocity, $v^2(R)$, at a radial distance R is related to the density, $\rho(r)$, according to the relation ship:

$$v^{2}(R) = 4\pi G (1 - \epsilon^{2})^{\frac{1}{2}} \int_{0}^{R} \frac{\rho(r) r^{2} dr}{\left[R^{2} - \epsilon^{2} r^{2}\right]^{\frac{1}{2}}}$$
(1)

Here G is the gravitational constant and ϵ is the eccentricity of the elliptical cross-section of a sequence of spheroids which are concentric, coaxial, of equal eccentricity, and each of which can be viewed as being of uniform but unequal density (i.e. a spheroidal homeoid sequence). Hence R is the semi-major axis of the outermost shell.

Subsequently⁵ it was shown that if $\epsilon = 1$ (actually $\epsilon \ge 0.86$ for the two clusters under consideration) then the total mass, M(R), interior to R is given by:

$$M(R) = \frac{2}{\pi G} \int_{0}^{R} \frac{v^{2}(r) r dr}{(R^{2} - r^{2})^{\frac{1}{2}}}$$
(2)

The general expression which was found to fit galactic rotation-curves was discovered, in a series of papers,⁶⁻⁹ to be of the form:

$$v(r) = \frac{v_m r}{R_m} \left[\frac{3}{1 + 2 \left(-\frac{r}{R_m} \right)^n} \right]^{3/2n}$$
(3)

where v_m is the maximum velocity of the rotation-curve which occurs at a radial distance R_m and n is a constant which is determined by a best fit of the equation to the data. A number of curves of the form of Equation (3) can be summed as their square (i.e. add their kinetic energy contribution per unit mass) so that an even more general form results which can briefly be written as:

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Symbols Used in the Text

- b the angular distance perpendicular to l_{i} ·
- bc the value of b of a cluster center.
- G gravitational constant.
- i, j integers.
- the number of velocity curve components summed to make one rotation curve.
- K a constant.
- angular distance measured from celestial equator along major axis of cluster.
- lc the value of l of a cluster center.
- m.e. mean error of sample.
- MM mass of main cluster.
- M_0 total mass interior to the first maximum of the k-components of the velocity curve sum.
- M(r) mass interior to r.
- Ms mass of Southern extension cluster.
- MT total mass of a cluster.
- M_v virial theorem mass estimate.
- n a constant.
- ni the value of n for the i^{th} component of velocity curve sum.
- N number of objects in a sample.
- P period.
- r radial distance from center of mass.
- R radius of outermost spheroid under consideration.
- \overline{r} average value of r of sample.
- R_m the radial distance at which v_m occurs. R_{m_i} the value of R_m for the ith component of velocity curve sum.
- RMC distance from center of main cluster to dynamic center of both clusters.

Rsc - distance from center of S. ext. cluster to mutual dynamic center. \overline{v} — average velocity of sample. vi(r) — the ith component in the rotation curve sum.

- vm maximum value of velocity of rotation curve.
- v_{m_i} the value of v_m for the ith component of rotation curve sum.
- v(R) circular velocity at R.
- ∝c right ascension of cluster center.
- δc declination of cluster center.
- ϵ eccentricity of the elliptical cross-section of the spheroid.
- $\rho(\mathbf{r})$ density at r.
- standard deviation of average velocity.

$$\mathbf{v}(\mathbf{r}) = \left[\sum_{i=1}^{k} {\mathbf{v}_{i}}^{2}(\mathbf{r})\right]^{\frac{1}{2}}$$
(4)

where $v_i(r)$ is the value of Equation (3) for the i^{th} peak at v_{m_i} and R_{m_i} .

The galaxy cluster case, however, differs significantly from the galactic case. First of all, from the relative sharpness of the spectral lines of the latter there does not appear to be a sizeable fraction of stars which deviate significantly from the mean local circular motion. Now this fact may square with the cloud-collapse hypotheses of galaxy formation, but seeing that the local stellar count density in the vicinity of the sun, coupled with radio-based estimates of the interstellar mass-density is not enough to be explainable in terms of a cloudcollapse origin¹⁰ one is not justified in assuming that all the members of a galaxy cluster revolve in the same direction.

In fact, Figure 1 reveals a zone in which the number of galaxies moving in direct orbits equals the number moving in the opposite direction, so that the average velocity ends up being zero. Although the problem of a cloud collapsing to a galaxy is more readily solved than that of a cloud collapsing into stars, this observation of the Virgo cluster's orbital mixture could prove to be every bit as difficult for the cloud-collapse hypotheses to overcome.



Figure 1. The raw rotation-curve before rectification, showing the radial velocity, in km/sec. (plotted vertically) vs. the longitude in degrees. The number N of objects included in the average for a point is indicated by the point as follows: asterisk, fewer than 5; cross, 5 or more but fewer than 10; dot, 10 or more but fewer than 20; hollow square, 20 or more but fewer than 30; solid square, 30 or more. The upper horizontal line is the radial velocity of the main cluster; the lower is that of the Southern extension. Members of the group NGC 4261 could have been added, at about 7 degrees and extending from about 1700 to 2500; this suggests a rotation-curve. The last four data points at the right end of the main cluster's rotation-curve involve the galaxies proposed as members in this paper. The dips to the mean velocity of the cluster at 3.3 and at 16 degrees are zones in which the number of retrogade objects equals the number of direct; they seem to conform to a 6.5 degree cycle.

As a result of the failure of the unidirectional orbit hypothesis one must look at each member galaxy separately, and if necessary, change the sign of its radial velocity relative to the center of mass in order to have all objects moving in the same sense. For the inner portions of the cluster this amounts to assuming equipartition of velocity (analogous to equipartion of energy in physics). Hence the observed radial velocity average will be half the true value and the tangential velocity average (if it could be observed) would be $\pi/4$ of the true velocity. Thus, the observed average radial velocity should be multiplied by two, yielding the upper curves of Figure 4.

It was found that whereas Equation (3), with $v_m = 250$ km/sec, $R_m = 3^{\circ}.15$ times the scale factor (see Figure 4) and n = 1.75, does envelop the observed double peak for the main cluster of Figure 1, it does not drop off fast enough to account for the subsequent decline of the curve nor for the decline indicated by the data in Figure 4. A more powerful form of Equations (3) and (4) was searched for and found to be:

$$v(r) = 2r \left\{ \sum_{i=1}^{k} \left[\frac{3}{1 + 2 \exp[\{\frac{r}{R_{m_i}}\}^{n_i} - 1]} \right]^{3/n} \left(\frac{v_{m_i}}{R_{m_i}} \right)^2 \right\}_{(5)}^{1/2}$$

where k = 1 for the Southern extension's rotation curve in Figure 4b and k = 3 for the main cluster's rotation curve in Figure 4a.

Data Reduction

In all 111 galaxies with observed radial velocities are included in this study. Because of their high radial velocities (the highest of all in the sample) and because of their sizeable distance from the dynamic center, NGC's 4593* and 4939 were deleted from cluster membership. Although not previously recognized as cluster members, NGCs 4064, 4494 and 4565 meet all membership requirements and have been included here. The right ascensions and declinations (the celestial analogues of longitude and latitude respectively) of the member galaxies were first reduced to a clustercoordinate system.

Since the galaxies project to an ellipse on the background sky, the major axis was taken as the equator of the cluster and the resulting line intercepts the celestial equator at 1950 right ascension $12^{h}41^{m} \pm 2^{m}$ and at an inclination of $74^{\circ}.8 \pm 0^{\circ}.3$ measured counter-clockwise from the celestial equator. The cluster longitude is then measured clockwise-as seen from the northern hemisphere-along the cluster's equator and measured from the aforementioned point where the cluster's "equator" intercepts the projection of the earth's equator upon the sky.

To determine the center of mass position and velocity a raw rotation-curve was plotted (Figure 1). This was done by the sliding window technique, namely, by pigeon-holing the members into 1-degree intervals of cluster longitude, l, averaging and then taking a weighted average of the result with the averages of the intervals on either side of the given longitude interval. In effect this smears the data to about 3-degree resolution.

Figure 2 is also a smeared curve of the average value of latitude, b, and shows the deviation of the sample from the chosen equatorial plane. It indicates that the cluster is not totally relaxed. The time required for a galaxy to cross the mean amplitude is about 10^9 years (given the velocity dispersion times $\pi/4$).

Figure 3 is the rotation-curve in latitude which has been divided into the left and right halves of Figure 1 along with a composite.

It is apparent from Figure 1 that a division of the cluster into a main body and the Southern extension is justified; the division between the two occurring near $l = -1^{\circ}.5$. On the basis of the symmetries of the curves

^{*}The NGC designation refers to the number assigned the object in the NEW GENERAL CATALOGUE of Nebulae and Clusters of Stars published by J. L. E. Dreyer in 1888. In 1971 it was reprinted by the Royal Astronomical Society in London.



Figure 2. This shows the latitude of objects vs. longitude, both in degrees. Thus it indicates the deviation of the average latitude of the sample from the assumed equatorial plane of the cluster. Again the last four data points on the right, for which *l* is more than 20 degrees, involve the proposed members. If the chosen equatorial plane differed significantly from the true plane then a straight line of constant slope would be expected. Instead, the periodicity of the curve suggests that the cluster is not relaxed. The group NGC 4261 is shown here as a single data point. It could not be the cause of the distortion, for its mass is only about 0.6% that of the cluster, while the total amplitude of the distortion is about a megaparsec.

Table 1.

Parameter	Main cluster	S. Ext. cluster
l_c	$10^{\circ}.2 \pm 0^{\circ}.2$	$-5^{\circ}.0 \pm 0^{\circ}.3$
b_c	$0^{\circ}.6 \pm 0^{\circ}.4$	$0^{\circ}.8 \pm 0^{\circ}.4$
$\overline{\mathbf{V}}_{\mathbf{c}}$	1160 km/sec	1110 km/sec
α_{c}	12 ^h 33 ^m	12 ^h 52 ^m
δc	10°31′	-05°00′

Table 2.

Ν	v	m.e.	r	m.e.	comments
Ma	in Clus	ster:			
1	1044	22	0.47	0	l°average
8	633	168	1.52	0.10	2° average
27	479	38	2.11	0.11	0
43	561	30	2.77	0.13	
47	489	29	3.41	0.12	
34	587	38	4.26	0.13	600 k/s w. 4261 as one
25	442	39	5.36	0.19	535 k/s w. 4261 as one
23	582	37	6.72	0.14	599 k/s w. 4261 as one
21	507	34	7.20	0.15	
16	504	50	8.00	0.22	
9	287	44	9.44	0.26	
8	246	49	10.33	0.31	
6	217	60	11.68	0.92	5° average
1	88	27	16.05	0	l°average
12	87	76	18.31	1.00	S. Ext. cluster
Sou	thern]	Extensio	n Cluster	:	
2	148	36	0.61	0.31	l°average
3	243	98	0.91	0.35	2° average
4	182	92	1.24	0.42	
5	331	35	2.89	0.44	
6	261	43	3.77	0.40	
6	276	46	4.24	0.32	
4	209	64	5.32	0.39	
3	62	45	7.12	1.38	5° average
2	92	57	8.12	1.65	4° average
1	41	26	9.77	0	l°average

Table 3. Main cluster (k = 3)

i = 1	i = 2	i = 3	S. Ext. $(k = 1)$
660	605	110	330
0.75	2	2	0.9
0.22	1.23	2.64	0.55
1	5.6	12	2.5
	i = 1 660 0.75 0.22 1	i = 1 $i = 2$ 6606050.7520.221.2315.6	i = 1 $i = 2$ $i = 3$ 6606051100.75220.221.232.6415.612

of Figures 1 through 3 the center of mass parameters for the two clusters are tabulated in Table 1.

When the rectification described in the previous section using these parameters was accomplished the results were plotted as Figure 4. Again the smearing was done as described above, but not all points are smeared to the same degree. This can be seen in the comments column of Table 2 which lists the relevant averages for the two clusters. All error bars in the figures and columns labelled "m.e." are mean errors. In Table 2 "N" indicates the number of galaxies considered in the average, v is the average observed radial velocity corrected for retrogrades.

For the Southern extension case the contribution of the rotation-curve of the main cluster has been removed. The column labelled r lists the average distance from the center of mass of the N objects. The members of the NGC 4261 group (NGC's 4260, 4261, 4270, 4273 and 4281) were not included in the data of Table 2 but they are treated as one object in three entries in the "Comments" column. Their deletion does not appear to have a significant effect on the final results.

The Density Distribution

Given that the mass is expressed by combining Equations (2) and (5) then, from the definition of a spheroidal homeoid sequence, it follows that the density can be expressed as:

$$\rho(\mathbf{R}) = \frac{3M(\mathbf{R})}{4\pi \mathbf{R}^3 (1 - \epsilon^2)^{\frac{1}{2}}}$$
(6)



Figure 3. The rotation-curve along l = 10.2 degrees, or in latitude. Again radial velocity is plotted vs. average latitude; note, though, that the vertical scale starts over again at intervals. Part a includes all objects having l no more than 10.2 degrees; part c shows that rotation curve for the rest of the cluster, i.e., for l more than 10.2 degrees. Part b shows the data combined, i.e., all l, to show the entire cluster's rotation-curve in latitude. The horizontal lines correspond to the radial velocity of the center of mass as defined by the symmetry of Figure 1.

The result for each cluster is presented in Figure 5 and is based on the values of the parameters to Equation (5) tabulated in Table 3.

The central density for the main cluster's rotation curve is about the mean density of a galaxy, namely 1.18×10^{-24} gm cm⁻³; but this may be rather on the high side since the curve i = 1 is open to challenge. If it is assumed that the density curve of the main cluster should run about parallel to that of the Southern extension then a central density of about $(3.5 \pm 1) \times 10^{-25}$ gm cm⁻³ is indicated. The central density for the Southern extension is $2.6 \pm 0.5 \times 10^{-26}$ gm cm⁻³. Both these values are at least about two orders of magnitude greater than the previous estimate of 2.9×10^{-28} gm cm⁻³ based on the observed light.¹¹ This result is consistent with the general discripancy that exists between dynamically determined masses and mass-to-light ratio



Figure 4. The rectified rotation-curves. All of the data points are plotted. Part a (top) is for the main cluster; b (bottom) is for the Southern extension, contribution of the rotation-curve for the main cluster having been subtracted out in accordance with the formalism of Equation (4). As expected, the upper $(2\overline{v})$ curves envelope nearly all of the data points, and appear to be on the high side beyond about 8 degrees where the postulate of equipartition of velocity breaks down. In both parts the vertical scale shows radial velocity; the lower horizontal scale of each part shows distance from the center of mass in degrees, the upper horizontal scales the same distance in megaparsecs. This scale is based on an assumed distance modulus of 30.5, which corresponds to a distance of 12.6 megaparsecs. Both the NGC 4261 group and the Southern extension cluster are presented as an averaged unit in part a.

determined mass estimates for galaxy clusters. It is hoped to investigate this further in a subsequent paper.

By defining edges to the clusters (at 25° for the main cluster and 12° for the Southern extension) one arrives at an estimate for the density between clusters belonging to the supercluster of $(2.2 \pm 0.8) \times 10^{-29}$ gm cm⁻³ which is about two orders of magnitude greater than the light-determined value of 3.1×10^{-31} gm cm⁻³ estimated previously.¹²

Total Masses

As was mentioned in the historical development section, there is a problem with mass-reversal. It has been shown¹³ that this follows from the theoretical rotation curve and that the mass has an inverse dependence upon the radial distance, R, for large values of R. For the galactic case this reversal is rarely, if ever, reached



Figure 5. The density. The vertical scale shows the logarithm to base 10 of the density; the lower horizontal scale, the distance in degrees from the dynamic center; the upper horizontal scale, the same distance in megaparsecs. The upper curve is for the main cluster; the lower, for the Southern extension. The steep rise near the nucleus of the main cluster is due to the i = 1 curve, the first maximum of Figure 4; and it is subject to question.

in the optical body of the galaxy; although it can be reached in the radio body. It can be shown, by equating centripetal and gravitational forces and substituting Equation (5) (with k = 1) for the resulting velocity dependence, that for large values of R the dependence of the mass on R for the cluster case goes as:

$$M(R) \propto \frac{R^3}{\frac{3R^n}{e^n}}$$
(7)

To circumvent the mass reversal it was assumed that the mass evaluated by combing Equations (2) and (5) was valid up to the point R_{m_i} and has a value M_0 . Subsequently, the rest of the cluster was divided into shells of uniform density each, the *j*th of which has a mass M_j , so that the total mass interior to a distance R from the center of mass is given by the sum of M_0 plus the contribution of all *m* shells exterior to M_0 :

$$M_{T} = M_{o} + \frac{4}{3} \pi (1 - \epsilon^{2})^{\frac{1}{2}} \sum_{j=1}^{m} (R_{j}^{3} - R_{j-1}^{3}) \rho_{j}$$
(8)

The resulting masses are:

$$M_{T}$$
(main cl.) = (2.6 ± 0.4) × 10⁴⁸ gm

$$= (1.3 \pm 0.2) \times 10^{43} \text{ solar masses};$$

M_T(S, Ext.) = (3.3 ± 0.4) × 10⁴⁷ gm (9)
= (1.6 ± 0.2) × 10¹⁴ solar masses.

The error terms are based on several different starting values of M_{\circ} .

If the assumed physics is consistent over the scale of the cluster then one expects that the distance from the center of mass of the main cluster to the center of mass of the double system, R_{MC} , and the distance from the center of mass of the Southern extension to the combined center of mass, R_{SC} , be related to the ratio of the masses of the two systems according to the expression:

$$\frac{R_{\rm MC}}{R_{\rm SC}} = \frac{M_{\rm S}}{M_{\rm M}} \tag{10}$$

where M_M is the mass of the main cluster and M_S is the mass of the Southern extension cluster. Now the radio center of the main cluster, VirA, is located at about

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 $R_{mc} = 2^{\circ}.8$ and if it is assumed that that is also the dynamic center of the main cluster then, according to the data of Table 1, the mass ratio should be 0.18 ± 0.04 . Assuming, on the other hand, that all galaxies in the main cluster have equal masses, then its center of mass occurs at $R_{mc} = 0^{\circ}.9$; corresponding to a mass ratio of 0.06. VirA does not occupy a central position when the cluster's symmetry is taken into account. Neither are the galaxy masses independent of position in the cluster; hence, averaging extremes, the mass ratio is 0.13 ± 0.07 . The clusters are $15^{\circ}.2$ apart which is the maximum size which either cluster can be assumed to have in this case. This yields a mass ratio of 0.15 ± 0.02 ; within the above range.

Refinement of the Virial Theorem

The virial theorem was originally developed in the kinetic theory of gases to express balancing of the motion of molecules against their mutual attraction. Here, instead of the molecules are galaxies; and gravity is the mutually attractive force. In the latter case the usual form is:

$$M_{v} = \frac{3R\sigma^{2}}{KG}$$
(11)

where R is usually taken to be the cluster radius, σ is the standard deviation of the velocity dispersion and K is taken to be a constant which is a weak function of cluster parameters and galaxy size. Estimates for K range from 0.29 to 3; the former being based on the assumption that the cluster can be approximated by a polytrope of index five.¹⁴

Since there are two rotation-curves, one can use the resulting mass determinations to determine an empirical value for K. Doing so and dividing the result into the factor of three in Equation (11) yields:

$$M_{\rm v} = (3.14 + 1.15) \frac{R\sigma^2}{G}$$
(12)

The error range in the above expression is rather large primarily because of the difference between the two clusters. There is some reason to assume that a larger sample from the Southern extension would increase the velocity dispersion enough to bring it more in line with that of the main cluster, thus decreasing the error range.

Period of Revolution

It is apparent from the data that the galaxies considered here can be viewed as members of a double system. The period of revolution, P, can be expressed as:

$$P = \frac{2\pi R}{v}$$
(13)

which is a continuous function of R. By considering the center of mass of the Southern extension cluster as the outermost member of the main cluster one finds that the revolutionary period of the system (velocity equipartition not assumed) is 4.1×10^{11} years if the data in Table 1 is used or 2.7×10^{11} years if Figure 4 is used. These

estimates are some 10 to 35 times the presently held age of the cosmos. One could ask whether or not such a period is compatible with the violent origin of the bigbang model.

Conclusion

Not surprisingly the mass determination based on the rotation-curve is compatible with that of the virial theorem. Another method capable of yielding a mass estimate involves counting the number of galaxies in the cluster with some estimate for their individual masses based on their total light output. When this is done the resulting mass is anywhere from about a tenth to a hundredth or more of the virial theorem mass estimate.

Discussion of the various resolutions proposed for that mass discrepancy will be reserved for a future article. In connection with the mass discrepancy, the application of the virial theorem to clusters of galaxies has been challenged. But that application is justified by the rotation-curve's mass estimate.

Relevance to Creationism

In the past, the mass anomaly has been used as an argument for a young cosmos. This has been done on the basis that according to the velocity dispersion (virial theorem) galaxy clusters should have disipated billions of years ago, given the "count" mass estimates.¹⁵ Valid though such an approach may be, it appears here that these clusters can be viewed as bound systems exhibiting, as indicative of their "boundedness", the property of rotation. Hence, such an approach may not be sound in light of this evidence, or may need to be reconsidered. This approach still appears to be applicable to those cases where doubles or chains of galaxies have extremely discordant radial velocities.

Yet this does not give support to the evolutionist's stance; for even though one argument is thus removed, two further arguments remain. As noted before, Figure 1 reveals two "dips" in the raw rotation curve of the main cluster. One of these occurs at $1 = 3^{\circ}.3$ and the other at $1 = 16^{\circ}.2$. These are not zones where objects are "standing still" with respect to the center of mass as one might at first suspect. If they were then there would be a clustering of points toward v = 0 near $R = 6^{\circ}.5$ in Figure 4a. Instead it appears that there is a shell of radius $6^{\circ}.5 (1.4 \text{ Mpc.})$ where the number of directly revolving galaxies equals the number revolving in a retrograde sense.

Inspection of Figure 3b shows the same effect in the latitudinal rotation curve with the suggestion that the prevailing direction of rotation may actually reverse beyond that distance. In this case, however, the effect appears about a degree closer to the center of mass than in longitude. Hence, one can tentatively conclude that a spheroidal shell, of eccentricity 0.5, exists inside the cluster in which the orbital directions are totally mixed. Interestingly enough, this shell appears to coincide with the ellipse which describes the outline of the cluster at their respective poles and yet appears to have about half the equatorial radius of the shape-describing ellipse. The first key point for the creationist stance is that no evolutionary model can explain this phenomenon.

The second point involves the time scale indicated by the very existence of a rotation curve as presented here. According to the usual figures quoted for the age of the universe the outermost members of the clusters have only had time to make about a tenth of a revolution. Since the relaxation time for such a system is at least several revolutions it seems rather strange that the motion, usually assumed to have been random initially, could have sorted itself out to the degree that it has and to the radial extent that it has in the evolutionist's time frame. On the other hand, since the Southern extension cluster has not been tidally disrupted by the main cluster it would appear that the system is not several revolutions old.

Finally, one may invoke the standard design argument here, too. It has been noted that matter appears to be distributed in a hierarchy, ranging from planets, to stars, to galaxies, to galaxy clusters and, apparently beyond to superclusters (i.e. groupings of galaxy clusters). Since all but the latter have been shown to rotate, † adding consistency to the hierarcy, and since an arrangement of things into a hierarchy implies planning and design, does that not point to the creation of these objects as being an organized system from the beginning?

Acknowledgements

The author is indebted to his parents for the financial support that made this study possible. The radial velocities used came mainly from three literature sources¹⁶⁻¹⁸ with some modifications and additions from the miscellaneous literature. All calculations were done on a Texas Instruments SR-52 calculator and copies of programs can be made available to any interested reader.

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H. J. MASSINGHAM: CHRISTIAN ECOLOGIST

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As the ecology movement became prominent in the last few years, Christians have sometimes been suspicious of it. However, since the aim of ecology is to make the world a better place in which to live, or to keep it from becoming a worse one, it would seem right for Christians to sympathize, and, if possible, to help.

A good way to show that something is possible is to show that it has been done. Thus, the purpose of this article is to show that it is possible to be a Christian and an ecologist by recounting something about a man who was both.

The life of the English writer and thinker H. J. Massingham (1888-1952) developed into a long, often painful, but ultimately successful quest for rural roots and spiritual fulfillment.

Massingham was born into a free-thinking, Liberal, late-Victorian family which was established in a progressive and thoroughly urban milieu. He ended his life as a firm believer in Christianity, a conservative (in the non-party sense that he advocated the conservation of traditional values) and a country-dweller who had abandoned the city and made his home in a rural environment.

A free-lance writer for most of his working life, Massingham produced numerous books on a wide variety of topics. He first made a name for himself as a nature-writer in the style of W. H. Hudson, but later extended his range to include more general regional and topographical subjects. He was always eager to further the cause of rural craftsmanship and traditional husbandry.

Although Massingham never became a practising Catholic, he was baptised into the Catholic Church in the early 1940s, his motive: "I wanted, so to speak, to sign on".¹ This involvement helps to explain the cluster of books written at this time which were concerned directly with the relation between religious beliefs and practices and the cultivation of the land. The books are his autobiography *Remembrance* (1942), *The English Countryman* (1942) and, perhaps most significant of all, *The Tree of Life* (1943).

One Over-Riding Theme

The over-riding theme of Massingham's 1943 book was best expressed by the extract from a letter which he had received from an unnamed naval lieutenant which he used to open his first chapter. I feel that the loss of the love of the land for its own sake and the loss of the Christian religion are the greatest tragedies this country has ever suffered.²

For Massingham, these two were inextricably interconnected.

This ecologist came to believe that the "ultimates of life"³ were represented in the sacred trinity of God, Man and Earth. Massingham found symbolic physical realization of this in the pattern of the medieval village-community where the open fields clustered around the manor-house and cottages which were all dominated by the hallowed fabric of the village-church.⁴

For Massingham, this analogy was no accidental parallel, for both are foreshadowed by, and implicit in, the pattern revealed in the Gospels: "The triune relationship of the good earth, the good husbandman and heaven over all is truly contained in the life of Christ" (TL, 26).

Massingham's Christ was, first and foremost, "the Christ of the Trades." "The King of Kings," he insisted, "was born in the village cow-byre" (TL, 18). Christ's mother was a peasant, Joseph a carpenter, and homage was paid to him at his birth by unlettered shepherds. Christ was born into a rural area ("The eternal 'I Am' made his temporary home with the most immemorial of all human settlers on the cultivated ear-th" [TL, 20-1]). He taught through parables drawn from farming and husbandry and instituted "the informal ceremony of the Last Supper, wherein the unity between nature and the new faith is expressed in the sacramental aspect of the bread and the wheat" (TL, 25). The relation between his life and teachings and the eternal processes of country life was both natural and organic: "If the birth of Christ be the meeting of man and God, the farmyard is the meeting-place of man with nature" (TL, 18).

Massingham stressed the rural matrix of Christianity because he was aware that the temptation to stress the spiritual world at the expense of the physical creation

¹³See reference 5.

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had proved a serious and, to himself, a fatal stumblingblock in Christian thought and practice. For this reason he discussed at some length those aspects of Western Christianity wherein the vital relation between the two had been maintained successfully. He noted that attachment to nature was an intrinsic part of Celtic Christianity, and commented:

If the British Church had survived, it is possible that the fissure between Christianity and nature, widening through the centuries, would not have cracked the unity of Western man's attitude to the Universe (TL, 40).

Massingham praised the early Cistercians who "practised a husbandry in which farming was part of religion, and religion was in daily contact with nature" (TL, 52). He also praised the long line of parsonnaturalists, such as Gilbert White of Selborne, for demonstrating the wisdom of God in his creation. Gilbert White was one of the earliest English ecologists whose Writings Massingham had edited in a handsome two-volume edition in 1938. Massingham saw no way in which Christianity could be rejuvenated until it came to realize

that its own division from nature has pauperized it as an all-sufficient gospel for modern, grown-up, Western man, wrecked in the bitter sea of his delusion of self-will (TL, 17).

Close Analogies Cited

Massingham also saw close analogies between the Roman *latifundia* at the time of Christ (one of the causes of the eventual break-up of Roman civilization) and the Enclosure movement in England which reached a peak in the late eighteenth century and spelt the end of a traditional peasantry.

The subsequent history of Industrial man, with the conquest and exploitation of nature replacing peaceful co-operation, has produced the problems of overpopulation, pollution of the environment, and the misuse of natural resources. Massingham forecast it a generation ago:

Nemesis for running athwart the natural law is already in operation, both from the kingdom of nature and in the society of man, and no matter what subject be taken nor at what angle the causes of that nemesis be examined, the failure of the modern experiment is seen to be so because it is anti-Christian, anti-natural and anti-realistic (TL, 173).

Now that society is beginning to reap the whirlwind of the Industrial past (and the appropriateness of the rural and biblical allusion found in Hosea 8:7 would not have been lost on Massingham), suspicion of "Progress" has become almost common-place. But when Massingham was writing, this was a revolutionary and, to many, a willfully eccentric position. As a result, his was the voice of one crying in the wilderness.

The irresponsible conversion of good agricultural land into building-sites, accepted by a centralized government which neither knew nor cared about the consequences, had proceeded unchecked until the war demonstrated in no uncertain fashion the vital importance of a native agriculture. Although the threat of soil-erosion ought by Massingham's time to have been obvious, his warning ("once contemporary farming starts 'progressing,' it heads straight for the Dust Bowl" [TL, 148]) went generally unheeded. The overuse of chemical fertilizers and pesticides, the dangers of deforestation and indiscriminate hedge-grubbing, the effects of pollution on rivers and streams, were all subjects on which Massingham argued from a minority position that has since been justified.

Massingham's attitude to the agricultural and scientific trends of his time should not be seen as wholly critical and destructive. Though his diagnosis was gloomy, he offered constructive proposals to assist in recovery.

Despite an accident that resulted in the loss of a leg, Massingham devoted his energies to the dissemination of ideas that he considered essential for a revival of sound agricultural methods. To this end he edited three books each of which brought together the opinions and recommendations of experts who shared many or all of his principles. These three books were England and the Farmer (1941), The Natural Order: Essays in the Return to Husbandry (1945) and The Small Farmer (1947). They contained essays on such subjects as "Soil Fertility," "The Reclamation of Grasslands," "Self-Sufficiency," "Mechanization and the Land" and "The Homestead Economy." Here and elsewhere he un-tiringly warned of the dangers of monoculture and put the positive case for small and mixed farms. This case was argued from an economic viewpoint in terms of practical efficiency and from a psychological viewpoint in terms of personal human fulfillment.

Meaning of Husbandry

Massingham's introduction to *The Natural Order*, appropriately titled, sets the whole subject in a broader perspective, involving the religious perspective. The "husbandry" to which a return is advocated implies more than sound farming methods and healthy attitudes towards the land. It includes

the proper balance of town and country, the full development of the home market, agriculture the *only* primary industry, the abandonment of the idiocy of long-distance farming by urban clerks and officials who try to cheat nature with their own little industrial gadgets, the recovery by the country of its indispensable self-government and therefore

the recovery of local and personal responsibility.⁵ We shall not, he insists, even comprehend the true meaning of husbandry "unless we relate it to the first principles of the natural law, which is an earthly manifestation of the eternal law" (*NO*, 7).

A counsel of perfection? The daydream of an impractical visionary? Perhaps, though it would be a mistake to label Massingham as a die-hard reactionary. He made a firm distinction between natural change and artificial progress, and his arguments were based on knowledge, not mere sentiment. Many of his opinions, ridiculed in his own time, are being considered much more seriously today. Conversely, much of what he advocated has been ignored, and the results of moving in the opposite direction (Britain's current and continuing economic dilemma is the most obvious instance) are hardly encouraging.

It is true that some of his work has dated. Archaeological discoveries since his death (for instance, the implications of radio-carbon dating and the findings at Olduvai) suggest that some of his arguments derived from what is known of prehistoric man must be qualified.

Some of the farming methods he opposed have had a greater short-term success than he anticipated, though whether long-term effects may offset this remains to be seen. The triumphs of one generation tend to become the curses of the next (a fact that made Massingham suspicious of all quick solutions), and it may be a long time before a balanced assessment of his criticisms and recommendations will be possible.

But, whatever qualifications of detail may have to be made, his overall "philosophy" (if that is not too abstract a term) remains impressive. His faith in the ultimate unity of "Mother Earth and the Fatherhood of God" (TL, 15) is a continuing inspiration. His attitude is constant without being inflexible.

Above all, his vision is one of life. The local community is seen as "the cell of the national body corporate" (R, 120); membership of the Church is seen in terms of "the idea of the cell within the organic body" (R, 125). "Organic," "living," "growth" are keywords. He never despaired. Even when most pessimistic he was always prepared to hail "the germination of a new sacramentalism towards nature which is implicitly religious" (TL, 189). Appropriately, his confession of faith at the close of the twelfth chapter of *Remembrance* ends with the words, "Spero et credo."⁶

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GENETICS AND CREATION STUDIES[†]

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Modern creationists, with few exceptions, have not given much attention to modern genetics. Yet the study could be most useful. On the other hand, it reveals many difficulties for evolutionists. Indeed, the subject might better be called, not evolutionary genetics, as is sometimes done, but rather population genetics.

In this article much recent work is mentioned. Difficulties are pointed out for both theories commonly proposed from an evolutionary viewpoint: the classical theory and the balance theory. But some points emerge which creationists have come to believe on other grounds, for instance, that many creatures have far more potential for variation than has been suspected until recentley. This can be seen to be a provision by the Creator, to allow creatures to cope with changing conditions which might arise.

The "evidence" for alleged macro-evolution is generally collected from many different disciplines. Still, decisive proof, if any, might be supplied by two scientific areas only; other disciplines might furnish only "circumstantial evidence".

It is clear which these two areas are: *geology* and *paleontology* should supply the *historical* evidence (fossils, essentially) which would prove that a general evo-

lution had actually taken place. And *genetics* should display the *biological* mechanisms which prove that a general evolution is actually possible and likely.

Modern creationists have dealt a lot with historical geology and paleontology, but relatively little with modern "evolutionary" genetics. Their arguments usually amount to stating that natural selection only eliminates harmful mutations, and that mutations are very rare and nearly always deleterious. Such a simplification involves two dangers: first, that of seeming to ridicule a very difficult and rich science practised by some very bright scientists; and second, of missing the important recent discoveries which, properly understood, strongly support the creationist point of view.

Modern "evolutionary" genetics is, of course, based on a strong presupposition which is directly expressed in the name. This presupposition is that general evolution has in fact taken place. The name "evolutionary genetics" implies this; but it promises far too much.

[†]This article consists basically of material which was presented, under the title, *The Present State of "Evolutionary" Genetics*, at the Third National Creation Science Conference at Minneapolis, MN, 15-18 August, 1976. The abstract, illustrations, and some of the references, have been added for the present paper.

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The evolutionist and the creationist, in fact, agree perfectly on one point: that "evolutionary genetics" has nothing to say whatsoever on the problem of the supposed general evolution. That is, it has nothing to contribute to the problem how genera, families, and all the higher taxa may have originated during the supposed general evolution. It should therefore be simply called "population genetics", or, if preferred, "speciation genetics"; because it may only hope to say something about the origin of new species—which are no problem for the creationist. Yet, even in this respect this science is still very weak. The geneticist professor Richard C. Lewontin wrote¹ in 1974:

While population genetics has a great deal to say about changes or stability of the frequencies of genes in populations and about the rate of divergence of gene frequencies in populations partly or wholly isolated from each other, *it has contributed little to our understanding of speciation and nothing to our understanding of extinction.* Yet speciation and extinction are as much aspects of evolution as is the phyletic evolution that is the subject of evolutionary genetics, strictly speaking" (Emphasis added).

Lewontin, zoology professor at Harvard, is a brilliant geneticist and one of the present leading evolutionists of the world. The quotation from his book describes the material that I wish to summarize, from the creationist point of view, in this article.

Genetic Variation

If Darwin made any valuable contribution to science it was the emphasis he laid upon variation. Instead of considering variations as annoying aberrations from stable and ideal standard types, his genius distinguished their enormous importance as a possible source of adaptation and speciation. The set of presuppositions on which the modern creation model is based fully allows for these phenomena.

However, Darwin made the fundamental error of extrapolating from variation to macro-evolution. But still, variation is the cornerstone of genetics; it is the triumph of modern genetics that it explains in one synthesis both the constancy and variation of inheritance. Modern genetics fails, however, to show the relevance of these concepts to the concept of general evolution; in fact, genetics even fails quantitatively to explain what happens on the species level.

The variation studies in genetics is twofold: genetic variation (consisting of discrete genotype classes of the classical Mendelian type) and *phenotypic* variation (usually quasi-continuous in character and the supposed target of natural selection). Now it has been recognized for a long time (though not by many laymen) that "evolutionary" genetics is not very much helped by a study of *single* mutants with *drastic* effects but by a study of *large* gene combinations with *slight* phenotypic effects.

However, here one meets with an essential weakness of "evolutionary" genetics. The really interesting hereditary traits (such as size, intelligence, fecundity, viability) are so subtly influenced by certain gene combinations that this genetic variation is usually completely overwhelmed by the whole genetic background and particularly by environmental influences. The variation one can measure is therefore actually uninteresting for the "evolutionary" geneticist; and what he is interested in is actually unmeasurable.

Two Views Proposed

Therefore, the central problem of "evolutionary" genetics at present is to assess the amount of *hidden* genetic variation, or, in other words: At what proportion of its gene loci is an average diploid individual heterozygous? Two important polar predictions have been made on this point, called by Dobzhansky the "classical" and the "balanced" theory of population structure.² The *classical theory* (*CT*), defended, e.g., by H. J. Muller, M. Kimura, J. F. Crow, T. Ohta, J. L. King, and T. H. Jukes, assumed (up till about 10 years ago) that at nearly every locus every individual is homozygous for a "wild-type" gene; in addition, it is heterozygous for rare deleterious alleles, at a few percents of the loci.

The balance theory (BT), defended, e.g., by Th. Dobzhansky, B. Spassky, F. J. Ayala, J. A. Sved, and W. W. Anderson, assumes, on the very contrary, that at nearly every locus every individual is heterozygous, that there are no such things as "wild-type" genes, and that the number of alternative alleles must be large at each locus (to guarantee permanent heterozygosity). See Figure 1. Unfortunately, creationists usually seem to have heard of the former theory only.

The implications of these two theories and their differences are large. (1) If the CT were correct, genetic differences between populations would be much more important than under the BT (and this would, for one thing, supply a stronger basis for racism, by the way).

(2) The CT assumes that the chief action of natural selection is to eliminate deleterious mutations, that the fittest genotypes are the homozygotes for the wild-type alleles at all loci, and that favorable mutations maintained in the population are extremely rare. The BT

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$$\begin{array}{c} \begin{array}{c} A_{3} & B_{2} & C_{2} & D & E_{5} \dots & Z_{2} \\ \hline \\ \hline \\ A_{1} & B_{7} & C_{2} & D & E_{2} \dots & Z_{3} \\ \end{array} \end{array} \begin{array}{c} \begin{array}{c} A_{2} & B_{4} & C_{1} & D & E_{2} \dots & Z_{1} \\ \hline \\ \hline \\ A_{3} & B_{5} & C_{2} & D & E_{3} & Z_{1} \\ \end{array} \end{array}$$
(b)

Figure 1. (a) The genotypes of two randomly sampled individuals from a population, according to the classical theory; + signs indicate wild-type alleles and m a deleterious mutant. Each individual is heterozygous for an occasional locus, the particular gene being different in each case. (b) The same, according to the balance theory; not only are most loci in the heterozygous condition, but different individuals are homozygous for different alleles at different loci when they are indeed homozygous. An occasional locus with only one wild-type form like D is not excluded in the BT; and an occasional allele, e.g. B_7 , may be very rare and extremely deleterious so that, like the CT, the BT predicts deleterious consequences of close interbreeding. assumes that natural selection chiefly occurs in the form of balancing selection, probably selective superiority of heterozygotes, actively maintaining the alternative alleles in the population.

(3) The CT assumes that speciation entirely depends on the occurrence of new favorable mutations and their maintenance in the population, which would make speciation (needing many new genes) a much rarer event than seems to be the case. However, the BT assumes that the genetic variation for speciation is already there, so that each new biotope should quickly lead to new speciation, indeed much more quickly than seems to be the case.

(4) The *CT* is deeply pessimistic; it states that genetic change can only be for the worse, and therefore supplies propaganda for a genetic elite and eugenic methods. The BT, strongly influenced by Herbert Spencer's view that evolution is essentially progressive, is profoundly optimistic; it states that natural selection usually "leads to increased harmony between living systems and the conditions of their existence" (Dobzhansky). However, Lewontin rightly remarks that neither view admits the possibility that genetic variation is irrelevant to the present and future structure of human institutions (values, morals, truth), yea, that the unique feature of man is that he is not constrained by his genes. The Marxist (if I am rightly informed) Lewontin agrees herein with the Christian, although their motives are totally different.

Attempts to Decide Which View is Right

Now, which theory is right? In other words, how much genetic variation is there in natural populations? Until about 1965 no definite answer could be given. Screening for "visible" mutations (with clear morphological effects) and lethal alleles (through complicated crossing techniques) has shown that such genes are extremely rare in natural populations, which seems to support the CT. However, the BT objects that by *heterosis* (relatively high fitness of heterozygotes) still a number of "balanced polymorphisms"³ for visible and lethal alleles may occur. Other attempts, such as studying the variation of so-called "fitness modifiers" (a third group of genes) and studying the fitness of heterozygotes, have also failed to distinguish between the CT and the BT.

The best evidence of widespread genetic variation for genes that are relevant to characters of adaptive significance has been obtained from *artificial selection* experiments. If artificial selection succeeds in changing, in a heritable way, the phenotypic distribution in a population, it follows that there must have been nontrivial amounts of genetic variation for that character in the population to begin with.

Now, the remarkable thing in the history of artificial selection is the high frequency of success. It has been responsible for immense changes in domesticated plants and animals (although the enormous contribution of the improved technology of husbandry and agriculture should not be forgotten); while in *Drosophila* population genetics it is a commonplace that "anything can be selected for" in a non-inbred population. The variety of possible selection responses is so extraordinarily large that genetic variation relevant to all aspects of the organism's development and physiology must exist in natural populations.

Although these results do not prove that *large* numbers of genes are segregating relevant to any particular character—even one locus could provide a slow and steady response to selection if heritability is low or if alternative alleles at the locus are near fixation—they do show that, if nearly any character can be selected for rather easily, many genes must be segregating in natural populations. This certainly contradicts the most extreme form of the CT which allows only a handful of rare mutations to be heterozygous in each individual.

Still, even if there were definite proof that a very large genetic variation exists in natural populations (which there is *not*) one still would be no closer to an accurate, satisfactory genetic description of populations, i.e., of the frequencies of alternative alleles at various loci in different populations and at different times. But this is exactly what would be needed for an "evolutionary" genetics!

ary" genetics! The methodological problems are enormous here. I pointed already to the dilemma that, on the one hand, phenotypic effects of various alleles at one locus must be distinguishable between individuals and from those of another locus so that ordinary Mendelian analysis is possible; whereas, on the other hand, what is really of interest is the variation that is the genetic basis of the *subtle* changes in development and physiology that make up the bulk of micro-evolutionary change.

These two demands, which conflict with each other, both conflict with a third demand for a program to enumerate genotypes in populations: if one wants to calculate what proportion of the genes is segregating in a population the assessable loci should be a random sample of all the genes, which requires that they be sampled irrespective of their variation whereas in fact they are studied because of their variation.

Molecular Genetics Applied to the Problem

The solution to these methodological dilemmas has been found in molecular genetics.⁴ The amino acid sequence of proteins is a phenotype that satisfies all the requirements mentioned because:

(1) a single allelic substitution is detectable unambiguously since it results in a discrete phenotypical change: the substitution, deletion, or addition of an amino acid.

(2) The conflict between the *discrete* phenotypic effects demanded by Mendelism and the *subtle* phenotypic differences relevant to micro-evolution is resolved by looking directly at the gene products and not at their physiological and morphogenetic effects.

(3) The apparent paradox of trying to detect invariant genes is resolved because invariant proteins can very well be detected in a population, and molecular genetics usually equates one protein to one gene (sometimes a protein consists of two polypeptides each coded for by a gene).

How can one use these considerations in a program for measuring variation? At the moment, one cannot use the primary amino acid sequence of proteins directly as a phenotype because it is just not possible totally

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Figure 2. A diagram of a vertical slab gel-electrophoresis apparatus. The positive and negative signs indicate the electrical poles. P indicates the sample pockets, in which the homogenate can be seen in its initial position. Under the influence of the electric field the negatively charged proteins move down, different kinds at different speeds; and the bands of protein, into which the kinds have been separated after the electrophoresis, can be seen.

to analyse the structure of scores of proteins in hundreds of individuals. What is needed is some characterization of proteins that is sensitive to single amino acid substitutions but allows reasonably rapid examination of many individuals and many proteins. For that purpose, geneticists have turned to the use of the physicochemical properties of proteins.

Most amino acids are electrostatically neutral; but two of them have a positive charge and two have a negative charge. A polypeptide made up of a mixture of these three types of amino acids will therefore have a net negative or positive charge, varying with the pH. If an allelic change at a locus results in the replacement of an amino acid by one with a different charge, the net charge of the protein will be altered. Such changes in net charges can be used to separate proteins and thus to identify the products of different alleles of the same

Figure 3. This shows allozyme phenotypes, as separated and revealed by electrophoresis. Above, homozygotes for six different alleles at the *esterase-5* locus in *Drosophila pseudoobscura*. Below, several different heterozygotes between alleles. Drawn after Hubby and Lewontin.

locus, by means of a technique called *gel electrophoresis*.⁵ This technique is illustrated in Figure 2.

About 10 years ago the first revolutionary results with this method regarding the central problem of "evolutionary" genetics were published. The group of H. Harris in London had studied 10 human enzymes,⁶ and the group of R. C. Lewontin in Chicago had studied eight enzymes and 10 larval hemolymph proteins from Drosophila pseudoobscura.⁷

Both studies showed a great protein variation; while in the *Drosophila* study it was shown that, for every varying protein and enzyme, the variation was the

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result of the segregation of alleles at single loci. See Figure 3. This allows the calculation of the amount of polymorphy and of heterozygosity in a population, and, moreover, the approximate equation of each of the invariant proteins to an invariant locus.

It turned out, in both studies, that a third (!) of all loci were polymorphic, and that the average individual is a heterozygote at one out of eight or 10 (!) loci. These estimates become even more impressive when one realizes that a majority of amino acid substitutions do *not* involve charge changes and thus escape attention. It is possible, therefore, that the average heterozygosity per locus is about 35%, and essentially every gene is polymorphic! At first view, the *CT* seems to be firmly refuted in favor of the *BT*; but, as will be seen, the situation might still be quite different.

Results Confirmed in Further Studies

Much more extensive and accurate studies, also in other species, followed the pioneer work of 1966, although the danger increased that studies were biased because of known variability. However, all the more recent adequate and reliable studies completely confirm the results of Harris and Lewontin.

In a dozen species examined the median proportion of polymorphic loci turned out to be 30% and the median heterozygosity per individual 10.6%. Remember that these are minimum estimates since they are based on only those gene substitutions that are detectable electrophoretically. Similar, though less accurate, results are known in several other species, including plants.

Although these results are impressive one really must ask how representative the genes examined are. They thus far have been restricted to genes coding for soluble enzyme proteins and a few nonenzymatic molecules; nothing is known of structural protein or of controlling genes.

There is evidence, it is true, that the soluble enzymes examined are representative of enzymes in general, and that the enzymes give a fair estimate for all the coded proteins. Still, one must remain very careful when it is considered that the few scores of genes examined in, e.g. man, are few indeed compared with the three million genes that might be coded for by the 3×10^{9} nucleotides in the DNA of each of his sperm.

Classical versus Balance Theory Reconsidered

It is striking that, apparently, natural selection can both preserve and destroy intrapopulation variation. Some cases of polymorphism have been clearly shown to be due to *balancing selection*, arising from a fitness superiority of heterozygotes over homozygotes or other causes. On the other hand, natural selection can decrease genetic variation in a population by selection against deleterious genes or against heterozygotes.

This paradox would have surprised Darwin, who recognized that intrapopulation variation is the source of the eventual interspecies variation, but had to assume that variation was constantly reduced by "the survival of the fittest" without knowing the source of new variation. This gap was filled by Mendelism.

The CT, however, is the direct inheritor of pre-Mendelian Darwinism because it still considers natural selection as antithetical to variation. It holds that the genetic basis for further (micro-) evolution is either lacking or extremely rare most of the time in the history of a population; because natural selection is efficiently sweeping out any variation that might otherwise accumulate.

On the contrary, the BT asserts the Mendelian possibility that natural selection preserves and even increases the genetic intrapopulation variation. It therefore regards adaptive evolution as immanent in the population variation at all times.

One might think that the clear evidence of vast quantities of polymorphism and heterozygosity would have utterly refuted the CT and firmly established the BT. This is not at all the case, however.

The *CT* has replied by stating that the substitution of a single amino acid, although detectable in an electrophoresis apparatus, is in most cases not detectable by the organism, and therefore may be completely indifferent to the action of natural selection. They are "genetic junk", or, *neutral mutations* from the standpoint of natural selection.

This new version of the CT has been called the *neo*classical theory (NCT) or neutral mutation theory, and its proponents *neoclassicists* or *neutralists*. It states that:

(a) *many* mutations, it is true, are subject to natural selection, but these are almost exclusively deleterious and are removed from the population;

(b) a second *common* class is that of redundant or neutral mutations, and it is these that will be found segregating when refined physicochemical techniques are employed;

(c) a third group consists of *rare* favorable mutations which will be fixed by natural selection (since "after all adaptive evolution does occur"!) and of *occasional* heterotic mutants.

It is to be noted that the *NCT* cannot be disposed of by pointing to instances in which single amino acid substitutions do have large consequences, or to occasional observations of balanced polymorphisms (like the wearisome single example of sickle-cell anemia), because the *NCT* does not deny that such cases exist, but only that they are common and explain a significant proportion of natural variation.

The argument is made up of two parts: (a) an attempt to refute the BT, and (b) an attempt to show that the NCT is compatible with the data. It is applied to two different sets of facts: (1) the amount of heterozygosity in populations, and (2) the rate of substitutions of alleles in micro-evolution. The NCT holds that both (1) and (2) are too large to be accounted for by selection but can be satisfactorily explained by assuming that the genetic variation is largely neutral and that structural differences in most proteins are the result of random fixation of the alleles concerned during micro-evolution. Consider briefly NCT statements about points (1) and (2):

(1) The large amount of heterozygosity. The most telling evidence against the BT as the explanation for the observed standing variation in populations is that the predicted "inbreeding depression" (i.e., decrease of fitness) under the BT would be vastly greater than what is observed unless heterozygote fitness is extremely

small. On the other hand, the application of the NCT to every case of heterozygosity can just as well be shown to lead to absurd results. Also, some results from studies on allelic frequency distributions between reproductively isolated groups are strongly against a hypothesis of random drift of allelic frequencies, i.e., the NCT.

(2) The high rate of allelic substitution. The rate of amino acid substitution in "micro-evolution" has been shown to be suspiciously fast under an adaptive theory (the BT), but is perfectly consonant with random, non-adaptive distribution as supposed by the NCT. However, the proponents of the BT have objected that, if indeed the vast majority of amino acid substitutions in micro-evolution have been the result of the random fixation of neutral alleles, the NCT would have to assume, even if it allowed as much as 10% of substitution to be adaptive, that neutral mutations are 4,000 times more frequent than mutations with a very slight advantage (0.1%), and in a more usual version of the NCT this is 40,000 times!

What Can the Creationist Make of This?

First conclusion for the creationist: It is quite embarrassing for the evolutionist that there are very strong reasons for rejecting both the BT and the NCT, which are the only elaborate models for explaining the genetic variation that is supposed to be the basis for evolutionary change! How can such a rich theoretical structure as population genetics fail so completely to cope with the body of facts? The problem must be in the structure of this science.

First, there are too many parameters in the theory that are not measurable to the degree of accuracy required so that often no discrimination between alternative hypotheses is possible. Lewontin says that where that is the case

the theory becomes a vacuous exercise in formal logic that has no points of contact with the contingent world. The theory explains nothing because it explains everything. It is my contention that a good deal of the structure of evolutionary genetics comes perilously close to being of this sort.⁸

Secondly, population genetics can only refer to equilibrium states and steady-state distributions, whereas in fact it should be applied to historical processes.

Thirdly, the usual treatment of the genome as a collection of single loci ignores both physiological interaction and linkage between genes. If different loci are correlated in their allelic distributions, then the dimensionality of the dynamic system is much greater than the number of loci.

It is the merit of Lewontin that he has urged that a theory needs to be developed which takes into account the "evolution" of the genome as a whole rather than the independent "evolution" of each gene.

It is likely that the very weak state of present "evolutionary" genetics will improve in the future. But at present every creationist may be assured that any assertion of evolutionists that genetics has proved that evolution is possible and likely is totally false. Not only has "evolutionary" genetics nothing to say to the supposed phyletic evolution, not only has it no quantitative model even for species formation, but it has not even reached agreement on the possible meaning of the genetic variation observed in natural populations.

Genetics of the Formation of Species

As was just stated, it is the irony of "evolutionary" genetics that it has made no direct contribution to Darwin's fundamental problem: the origin of species. It is not that there are no interesting theories about it; but geneticists are a long way from describing speciation in general genetic terms to constructing a quantitative theory of speciation in terms of genotypic frequencies.

This is a long way off, largely because virtually nothing is known about the genetic changes that occur in species formation. To have even the beginnings of a quantitative theory of speciation it is necessary to characterize the genotypic differences between populations at various stages of phenotypic divergence; but even such a characterization has hardly begun.

The general theory of geographic speciation postulates, on the basis of some evidence, that the speciation process begins with a geographical isolation between populations. After that, some distinguish three subsequent stages which are briefly considered here, with a summary of the evidence collected for each of these stages:

($\overline{1}$) Reproductive isolation, i.e., the appearance of genetic differences sufficient to restrict severely the amount of gene exchange that can take place between the populations if they should again come into contact. This might be largely caused by a divergence in ecological niche; but this point is still very vague. Now the genetic question is: How much and what kind of genetic differentiation is required for primary mechanisms of reproductive isolation to arise? Which fraction of the genome is involved in it?

Information to this first stage is nearly completely lacking. Only one case has been studied in which populations had newly acquired reproductive barriers in isolation from each other. S. Prakash discovered between 1967 and 1972 that the Bogota population of *Drosophila pseudoobscura* (which is far removed from all the other *pseudoobscura* populations) is in the first stage of becoming a new species.⁹

One of the first steps of this process is apparently that Bogotá females crossed with males from any other locality produce completely sterile sons, while the reciprocal cross produces normal sons. The Bogotá population probably colonized the area not much before 1960, apparently from a small number of flies; because a study of its genetic variation showed that it is only half as heterozygous as the rest of the species populations.

The genetic basis for its apparent reproductive isolation must be very restricted; because there has been no genetic differentiation at the 24 loci examined for it. The distribution of some of these species is shown in Figure 4.

(2) The reinforcement period, i.e., the renewed contacts between the isolated populations and the subsequent reinforcement of the reproductive barriers by natural selection, in that the newly arisen physiological differences cause hybrid offspring to be less viable or fertile so that they are selected against. Here the genetic

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question is: How much more genetic divergence must occur to produce ecologically differentiated, stable members of the species community?

Evidence for this second stage is also very scarce. The chief difficulty is how to recognize sympatric elements as being in their second speciation stage. On the one hand, some morphological or cytological differentiation between the entities must be observable; on the other hand, evidence of selectionally less favorable hybridization between them must be available.

A few cases are known: the pair of subspecies of the house mouse in Denmark, and the complex of "semispecies" of *Drosophila paulistorum* in South America. In the last case, there is not yet a marked genetic differentiation among the semispecies, whereas there is a considerable differentiation within the group of four sibling species to which *D. paulistorum* belongs, the socalled *willistoni* group.

(3) The completion of speciation, i.e., continued, mutually independent micro-evolution, each of the newly formed species becoming simply a part of separate communities of species undergoing further splitting or extinction. The genetic question here is: How much genetic similarity is there between more closely or less closely related species? What is the rate of independent genetic divergence in absolute and "taxonomic" time?

This is the stage about which a little bit more is known although: (a) studies are difficult because artificial hybridization between species, completely isolated reproductively in nature, is rarely possible; and (b) when species are farther removed from each other the only reason for saying that they have common ancestors may be the evolutionistic prejudice (i.e., the question may be begged).

Investigations have concentrated upon morphological differences or chromosomal bases of hybrid sterility but have yielded very few quantitative data about how much genetic difference there is between species. Here again the geneticists were led to the study of a random sample of specific enzyme and protein molecules by means of gel electrophoresis. By use of enzymes of which the genetics have been established by intraspecific study, species can be sampled and compared even when they cannot be crossed; although crosses should be made whenever possible to establish gene homologies.

The pioneering work in this field was done in two studies by Hubby and Throckmorton in *Drosophila virilis* and its relatives.¹⁰ First, they compared soluble proteins from ten species (divided into two phylads) of the *virilis* group. Although several difficulties made their analysis imprecise (largely because the genetics of the group was then unknown), the results suggest that on the average about 14% of the proteins of each of the species may be unique to it, and that the ten extant species most probably trace back to four immediate ancestral forms.

It was concluded that at a minimum of 8.5% of the proteins in the extant species have arisen since their speciation, during whatever stage (1, 2, or 3); and that at a minimum 23.5% of the proteins have changed from the ancestral form of the two phylads.





The second study was more precise because it was restricted to enzymes and larval hemolymph proteins, each of which is the product of a separate gene. Nine triads of species were chosen, two members of each triad being (morphological) sibling species, the third being a nonsibling member of the same species group. The results showed a much greater degree of genetic divergence than the results of D. virilis had suggested, but also corroborated the view that total morphological similarity between species is a reliable indication of genetic similarity.

A strong improvement of such studies would be not to compare single strains of all the species examined but allelic frequency patterns in related species. Prakash did this in the sibling species *D. pseudoobscura* and *D. persimilis.*¹¹ The remarkable result was that there turned out to be very little differentiation in gene frequencies, and not a single case of even near-fixation for alternative alleles in the two species. This suggests that species-differentiating genes must be relatively small in number, probably less than 10% of the genome. This is the more remarkable in view of the high degree of polymorphism *within* species.

Later investigations by Ayala and Powell¹² revealed that, for these two species, there are four "diagnostic" loci out of 39 studied, i.e., loci for which the frequencies of the diploid genotypes are sufficiently characteristic for a species to assign an unknown individual to that species with a probability of error of 0.01 or less. These authors carried out the most extensive and interesting comparison of gene frequencies among species, viz. in the four sibling species of the *willistoni* group. They found several instances where species are nearly fixed for alternative alleles, but also some impressive similarities between pairs of species at highly polymor-

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phic loci. The fraction of diagnostic genes varied between 14 and 35%.

Second conclusion for the creationist: All these observations together imply that where species are highly differentiated in their alleles there is at least a low-level polymorphism in one species for the genes that characterize the other. There is then a potential genetic transition between species that does not require the chance occurrence of new variation by mutation, i.e., the overwhelming preponderance of genetic differences between closely related species is latent in the polymorphisms existing within species.

Even when species diverge farther and farther in the course of micro-evolution within a genus this greater differentiation requires only the occasional input of mutational novelties, while the earlier stages (1, 2, and 3) make use of an already existing repertoire of genetic variation. These very interesting observations are the chief consequence, for the process of speciation, of the immense array of genetic variation that exists in populations of sexually reproducing organisms.

For the creationist, this is a very important conclusion because it accurately confirms one of the predictions of the creation model, "involving creative forethought on the part of the Creator, who equipped each kind of organism with a wide variety of potential structures to enable it to adapt rapidly to a wide variety of potential environments in order to conserve and preserve its basic kind".¹³

The creation model predicts that *micro-evolution* is not based on the occurrence of random, deleterious mutations but is adaptation based on the innate genetic variation in populations, a prediction fully confirmed by the molecular-genetical results of the last ten years. "Evolutionary" genetics assumes that the appearance of many novel genes plays a role only in much later stages, possibly macro-evolutionary stages beyond the limits of the basic "kinds". But since macro-evolution does not happen, such things would be irrelevant.

The Assessment of Natural Selection

Neo-Darwinism is based on two notions: random mutations and natural selection. Yet it is totally unknown what proportion of the supposed evolution, or even of micro-evolution, could be possibly ascribed to natural selection. Indeed, evolutionists strongly disagree on this point: for the BT, natural selection is the causative agent in the divergence between isolated populations; for the NCT, natural selection is always primarily a cleansing agent, sifting out unfavorable gene combinations.

Moreover, studies of genetic variation have not enabled the geneticists to discriminate between these two theories. Now, one could entirely reverse his approach to the problem of whether natural selection mainly conserves genetic variation, or, conversely, decreases it (i.e., whether the *BT* or the *NCT* is right) by trying to measure natural selection directly in nature.

The problem is that it is impossible to determine the over-all importance of balancing selection by demonstrating (by means of examples) that it exists. Of course it exits. But the question is: What *proportion* of observed genic variation is maintained by selection? This can only be solved by taking some *arbitrary* set of genetic polymorphisms and attempting to establish, for each case, the selective forces involved, through an exhaustive study of natural history and demography. This is the strategy of the school of "ecological genetics", largely inspired by E. B. Ford and the cradle of the BT.

The difficulty of such an "un-Popperian" strategy of confirmation rather than of exclusion is that if, say, 100 polymorphisms are objectively examined for balancing selection with a success of 98 positive cases, it could not be reasonably doubted (Popper or no Popper) that balancing selection is the chief cause of polymorphism; if, however, only two cases were proved it might imply either that balancing selection is unimportant or that it is extremely hard to demonstrate.

In fact, only a very few cases of evident balancing selection of polymorphisms have been proved, one of which, the case of the snail *Cepaea nemoralis*, is regarded as a paradigm by selectionists (*BT*). But even this rare instance is not without objections. What is necessary is, eventually, to measure the reproduction of the various genotypes at a locus and to calculate fitness values.

However, although there is no difficulty in theory in estimating fitnesses, in practice the difficulties are virtually insuperable. To the present moment *no one has succeeded in measuring with any accuracy the net fitnesses of genotypes for any locus in any species in any environment in nature*. Even attempts to estimate some individual components of fitness, involving the danger of giving a distorted picture of total fitness, have met with many difficulties.

Less pretentious attempts have restricted themselves to show at least that selection must be operating, even though it cannot be measured, by correlating the frequencies of alternative alleles with temporal and spatial differences in environment. A pretty large number of cases, published in, say, the last 10 years, has shown that undoubtedly polymorphism for electrophoretic variants is indeed under the influence of selection in some cases; nevertheless, they do not reveal how much selection goes on in nature.

If selection cannot be measured or even demonstrated as a general principle in nature, the selectionist can take yet another step back and make a still weaker demonstration. If it could be demonstrated that in laboratory conditions there was selection for some allele at a polymorphic locus, then it would be established that the substitution of such an allele does, in fact, make a significant physiological difference to the organism.

However, the record of detected selection of polymorphic enzyme loci in laboratory conditions is not a very large or convincing one. The most carefully designed and controlled work, that of Yamazaki¹⁴, revealed no selection.

Some geneticists have suggested that the fitness of a given genotype is not fixed but is *frequency dependent*. This would imply that a stable equilibrium of gene frequencies is possible without heterosis, indeed even with an inferior heterozygote. Such a specialized model of fitness can be justified from the simplest ecological consideration. If resources are in short supply and if

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each genotype exploits them in a slightly different way, then each individual is in more intense competition with others of its own genotype than with those of other genotypes.

Evidence of frequency-dependent selection, especially viability of larvae competing for resources, is abundant. On the other hand, all that this hypothesis has done is to transfer the problem of information from the sorting of genotypes ("genetic load") to the sorting of environmental niches.

The selectionist (BT) can still take one more step in his retreat from the direct measurement of fitness in nature. The *NCT* predicts that the vast majority of amino acid substitutions observed to be segregating in populations have no effect on the physicochemical properties of the enzymes, i.e., are selectively neutral.

enzymes, i.e., are selectively neutral. A valid attack on the *NCT* would then be a demonstration that the kinetics of different allozyme variants are indeed different. A number of studies of the activity of enzyme alleles did in fact show significant differences, sometimes correlated with clines in nature; this certainly puts the *NCT* in a shaky position.

Third conclusion for the creationist: Not only on the basis of changes in genetic variation is the geneticist unable to discriminate between the BT and the NCT, as was shown before, but it now appears that neither is he able to do so on the basis of observations of natural selection. On the contrary, it is still not even known whether natural selection plays at all a considerable role in micro-evolution, let alone that one could quantitatively determine this contribution.

Upon comparing this with the second conclusion, it is seen that, of the two elements of Neo-Darwinism: random mutations and natural selection, the first hardly plays a role in micro-evolution; and the second perhaps no more.

This conclusion is not an invention of fanatical creationists, but one that is explicitly drawn and corroborated in the important book of a convinced and leading evolutionist, Richard C. Lewontin.¹⁵ Neither need creationists repeat this conclusion with a sort of unholy glee, for creationists need have nothing against population genetics—on the very contrary!

No, there are other reasons to describe this present state of "evolutionary" genetics: if population genetics so far has not even supplied a quantitative description of micro-evolution the assertion that genetics has supplied a basis for a belief in macro-evolution is utterly unfounded. This simply takes away one of the pillars of the evolutionary doctrine—and creationists are well aware of the fact that the other pillar, paleontology, is not a bit more reliable.

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ANNOUNCING SPECIAL REPRINT

Some Christians believe that Charles Darwin, toward the close of his life, repudiated evolution and became enthusiastic for Christianity. That this did not occur has been reported by Dr. Wilbert H. Rusch, Sr., in a 1975 investigative paper on what Darwin wrote, and presumably believed, in the last two years of his life.

Now a special reprint of that paper "Darwin's Last Hours" is available for twenty-five cents (\$0.25)/postpaid per copy from the College Bookstore of Concordia College, 4090 Geddes Road, Ann Arbor, Michigan 48105. This will be a fine publication to give to those people who inquire about a possible Christian conversion of Darwin.

THE ORIGIN OF TERMITES

VINCENT A. ETTARI*

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New discoveries concerning this dreaded insect confirm the opinion which creationists have always held: that it is a special creation of God, not the result of evolution.

Distribution of Termites in Space and Time

Termites are well known around the globe; for indeed there is no place with a suitable climate which has escaped their influence. These animals form a highly knit society which literally eats millions of dollars worth of wood each year. Termites span every continent except the Arctic regions, and multiply in such numbers that if any group of animals should be able to provide evidence of evolution having occurred in the past or occurring today, this group should. It is therefore worthwhile to examine the evidences this group presents concerning its origin.

Termites have been around an amazingly long time on the evolutionary time scale. One authority (whose book will be used throughout this entire essay) comments:

The oldest fossil termite known is from the mid-Permian deposits in the Ural mountains. It is a wing just three-quarters of an inch long (*Uralotermes permianum*) and is almost two hundred million years old.¹

What is amazing about this discovery is that termite wings decay within two days.² Here is evidence of the fact that fossil material was formed extremely rapidly.

No Evidence that Termites Evolved

The origin of termites can only be speculated about as a consequence of the paucity of evidence concerning their appearance. Many authorities have admitted the termite group is not the only group in the insect world which is known to be without any preexisting transformations. For example:

The evolutionary origin of the arthropods is hidden in remote Pre-Cambrian times \dots^3

There is, however, no fossil evidence bearing on the question of insect origin; the oldest known insects show no transition to other arthropods.⁴

Of course, much speculation about their origin can be found in orthodox scientific literature, but naught is based on factual evidence. Not surprisingly, in this order the so called "biogenic law" does not apply. Instead, "The immature stages generally resemble the adults except that they do not possess wings."⁵

Termites always live in communities. They may be complex and may number several million individuals or may be relatively simple, the community consisting of a few dozen individuals only.

Social communities of anything like the same order of complexity as in the termites are found only in the *Hymenoptera* (ants, bees and wasps) and man himself, and it is of interest to note that something like a hundred million years separates each type of social organization in its development.⁶

According to the fossil record the oldest known individuals had the full capacity to maintain the complex social communities they do today. No individual of this class has ever been found without some type of society, one might say civilization, which other animal groups never seem to possess. Like the above cited animals, when the termites first appear they are already grouped in communities which possess a high degree of complexity. Yet, evolutionists support the belief that such communities arose naturally and separately, divided by a gap of hundreds of millions of years! Needless to say, the odds against such an occurance would cause the most complex computer to jam.

Termite Nests Air Conditioned

Consider a few of the accomplishments of these "primitive" animals. Termites possess a system by which they can regulate the very environment in which they live.

Termites live under conditions of static humidity controlled by the use of closed tubes or closed compartments, in which the termites live. In this way, they are able to allow either more or less water vapour from the atmosphere to enter the living space.⁷

Men finally gained the ability to do such as this only after many years of experimentation, and with the aid of highly complex machines at that. Yet here are organisms which have possessed the ability to control the climate of their living chambers from the first time they appear in the fossil record. And even more amazing is the supposition that they are derivatives of animals who possess naught of this ability whatsoever! By what means could termites have gained the ability to accomplish such a feat it they were not originally created with it?

How Termites Start New Colonies

The method by which termites start new colonies is also a feat which cannot be accounted for by a slow, naturalistic process such as evolution.

At certain seasons of the year the termites swarm by producing a large number of fully sexual individuals, males and females . . . This period of flying in the light, if only for a minute or so, is normally essential to the life cycle, but exceptionally it can be by-passed. The swarm of sexuals is often released at dusk, perhaps a defensive mechanism directed against the high degree of predation by birds,lizards, frogs, other insects . . ., and a host of other animals, including man himself.⁸

This mechanism must be perfect. If some termites were released while others were not (i.e. others from different nests), then the few termites who did swarm would be

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quickly consumed, leaving very few to colonize other areas. If the termites did not swarm at night they would fall easy prey to other animals which could easily pick them off during daylight hours. How do they know when to swarm? And equally interesting is the question how the termite workers know when the sun has set since they are blind.⁹ Yet it is this caste of termites which drives the reproductive termites to flight.¹⁰

Special Defense Mechanisms

Termite soldiers have defense mechanisms which are unparalleled in the insect world.

In some species "nasutes" are produced. These have large horny heads but the front is attenuated into a rostrum, from a terminal pore of which they are able to eject a fine stream of toxic material at an enemy.¹¹

The process by which this ability developed still eludes scientists who subscribe to the evolutionary theory.

Evolution within the insect world still remains a problem. For instance, one source presents a chart which illustrates the "probable" evolutionary order; but the evidence is still absent, of course.

In the accompanying chart the insect orders are numbered and shown in their *probable* development series . . .¹² (Emphasis added.)

Communication Among Termites

Termites appear to have a high degree of communication which does not depend on sight. Instead, it appears that the termites communicate by touch.

All termite species exist in social communities of a greater or lesser degree of complexity and it is now well known that such social organizations can only exist when there is a behavioural response between individuals which can be likened to language. This has brought about a co-ordination of activity and a task specialization in the termites of remarkable order, paralleled only in the *Hymen*optera, and by man himself . . . the communication between termites during feeding, defence, nestconstruction, foraging, etc., must be of a high order, especially when it is considered that these phenomena almost always take place in total darkness, so that visual signals are denied to them.¹³

It has also been discovered that termites of the same species are able to communicate with each other in a primitive manner by the laying of scent trails which attract other termites to follow along the same trail.¹⁴

(Referring to an accompanying picture) A worker termite meeting a nymph using the antennae for recognition sense.¹⁵

Termites as Gardeners

Termites also cultivate gardens of fungus, with which they form what amounts to a symbiotic union.

Amongst the termites of the subfamily *Macrotermitinae* the extraordinary phenomenon of fungus cultivation is practised . . . In the nests of these termites globular or ovoid cavities are found . . . These are the fungus gardens or "combs". They are perforated . . . by innumerable galleries of a size that termites can move about inside them . . . The genus of *basidiomycete* fungi found growing in the termite fungus gardens, *Termitomyces*, . . . are not known to grow wild, that is, away from the termite combs . . .

It now appears that the termites are constantly nibbling at the undersurface of the comb whilst at the same time renewing it. The substance which the termites are consuming is then wood substance which has passed through the gut, had a substantial part of the cellulose removed and is thus rich in lignin. This latter has passed through a stage of fungal degradation which has obviously led to the lignin having been rendered into a state in which it is more acceptable as a nutrient.¹⁶

This interesting state of affairs causes several problems with the evolutionary interpretation of life. First; How did the termites know that this substance would make lignin more acceptable to them? Always living in their sheltered world would make it impossible for them to discover such properties in this species of fungus. Second; How did this fungus, which can only grow in termite colonies, survive millions of years while the termites had not yet evolved? Once again, when put to the test the theory of biological evolution fails miserably.

Termites in Conflict with Ants

Defense against predators, especially ants, is amazing. For instance, many different types of soldier termites have been found each with its own specific military tactic.

When the colony is disturbed by . . . breakage of the nest . . . The soldiers . . . react by rushing immediately to the breach and . . . without actually leaving the nest, form a defensive guard with their heads all pointing outwards in the direction from which the aggressive act is presumed to have originated. Here they assume an attitude of counteraggression when they raise themselves on their legs arch their antennae forwards and open their mandibles. In some species . . . the soldiers immediately swarm to the outside of the nest which they cover Those species which forage above in masses. ground in the open maintain the outwardly directed soldiers on each flank ... The wide diversity of manibulate structure, however, gives rise to individual combat methods . . . Special methods of attack have been developed by those species with bizarre mandibulate forms; thus, Pericapritermes, with strongly asymmetrical jaws in which the left is very long, will attack only when the aggressor is on the right. As an auxiliary weapon the contents of the salivary gland are sometimes voided over the adversary . . . This then coagulates and binds the combatants together . . . The head of this "nasute" soldier is pear-shaped and a large proportion of the volume of the head is taken up by the frontal gland. The opening of the gland is . . . directed forwards and through . . . (it) . . . sticky . . . secretion can be expelled with such force as to reach several centimetres. Although blind, the nasute solider, by using
some unspecified sense, can aim at the aggressor with fair precision. 17

Even more amazing about these specialized defense mechanisms which are employed against the strategy of the ants is that these groups are separated by a hundred million years on the evolutionary time scale.

The behavioural implications of these warlike manoeuvres between these two social communities, separated by upwards of a hundred million years in evolutionary time, would well repay study.¹⁸

By subscribing to the evolutionary theory scientists will never to able to explain these enigmas. To date, the only plausible theory which offers any solution to such insurmountable problems is the theory of special creation.

Termites Have Not Evolved Resistance to Pesticides

Lastly, it is worthwhile to consider the effect of pesticides on termites. Evolutionists commonly point to certain strains of bacteria which have become resistant to antibiotics and claim that this demonstrates evolution by means of gene mutations and survival of the fittest. On the other hand, creationists maintain that some bacteria always were resistant because of immunities which were incorporated into the genes at their creation; and these show up when others are exterminated. Observation in the termite world seems to indicate that the latter is true.

ALDRIN . . . has now been under test for 14 years and is still 100 per cent effective.

CHLORDANE... has now been under test for 15 years and is still 100 per cent effective.

DIELDRIN . . . has now been under test for 14 years and is still 100 per cent effective.

HEPTACHLOR . . . has now been under test for 11 years and is still 100 per cent effective.¹⁹

Termites, not having the ability to build up resistance against pesticides, have been unable to do so. Bacteria, on the other hand, created with such an ability, have either been able to become resistant, or have always been so. In summary, it can be said that termites provide a great amount of evidence against both the godless theory of evolution and the attempted compromise of theistic evolution. Moreover, in-depth studies of all types of animal will yield evidence of comparable importance in favor of special creation.

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Note Added: It appears that termites have another special feature: they are able somehow to sense magnetic fields. See the 1976 article, What leads a termite through a magnetic field?, New Scientist 71(1014):391. The author has suggested that there might be a clue here to a way of making buildings termite-proof. A suitable arrangement of magnets might cause the termites to avoid the building entirely. It is about as hard to see how the ability to sense magnetic fields could have evolved as it is to see how the power of sight could have evolved. —Editor.

THE FIRST RECORDED DISCUSSION OF SPACE-TIME?

Objection 3: "... as a man can be distant in space, so also in time. But temporal distance impedes the knowledge of the separated soul—for they do not know the future. Therefore it would seem that distance in space would also impede the knowledge of the separated soul."

Reply to Objection 3: "Future things, distant in time, are not actual beings. And so they are not knowable in themselves, since a thing lacks knowability to the degree that it lacks being. Things that are distant in space, on the other hand, are actual beings, knowable in themselves. Thus the reasoning is not the same with respect to spatial and temporal distance."

From St. Thomas Aquinas, Summa Theologiae, Question 89, Article 7. (The knowledge of the soul separated from the body.)

(Is it not still a valid point, for use in Physics or Philosophy of Science, that the difference between past and future is of a different order from that between east and west?—Editor.)

A CLASSICAL FOUNDATION FOR ELECTRODYNAMICS

THOMAS G. BARNES,* RICHARD R. PEMPER,** AND HAROLD L. ARMSTRONG***

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Electrostatics, the study of the effects of stationary electric charges, is well established. Electrodynamics, the study of what happens when the charges are moving, has not been free from difficulties. The special theory of relativity is commonly supposed to be used to bridge the gap between the static and dynamic situations. However, that theory involves some notions, such as the contraction of lengths and the dilation of times, which are not well established experimentally. Moreover, it leads to some seemingly absurd results, such as the notorious twin paradox.

In the present article, the authors use the idea of feedback, in which changing electical fields cause magnetic effects and vice versa. These facts have been established experimentally for a long time. In that way a theory of what happens with moving charges is established. The results agree with those from the previous theory, but they are obtained in a way which seems physically more meaningful, and which does not require one to assume effects for which there is no experimental evidence.

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- T. Introduction II.
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I. Introduction

In 1865 James Clerk Maxwell introduced to the world his electromagnetic theory of light. On the basis of his four field equations, physicists have been able to explain almost the entire scope of electricity and magnetism.

Forty years later, Albert Einstein published his special theory of relativity. By introducing the postulate of the constancy of the speed of light and the two resulting concepts of length contraction and time dilation, he provided an explanation for the famous Michelson-Morley experiment.

In addition, Éinstein's coordinate transformations (often termed the "Lorentz transformations"),1 saved Maxwell's equations from the fault, as some saw it, of not being mathematically invariant in frames of reference, i.e., systems of coordinates, moving with respect to one another with constant velocity. The special theory of relativity has thus come to be considered one of the greatest achievements in science.

While it is true that special relativity has introduced to science many beneficial concepts, it must also be acknowledged that there are still various unresolved

problems in electrodynamics for which no solution has been forthcoming for the last seventy years. It may be that the trouble lies in the fundamental postulates underlying the theory of relativity.

This paper will begin by reviewing the present state of electrodynamics and will conclude with the presentation of a new theory. This new approach introduces a more physically plausible formulation of electrodynamics using only classical concepts and transformations.

_ II. The Present Theory of Electrodynamics

A. The Michelson-Morley Experiment

The well known Michelson-Morley experiment gave an unexpected answer. In this experiment a light beam was split into two beams which had paths at right angles to each other, and included mirrors to reflect each beam back to the starting place. The thought was that in one beam light would travel upstream and back through the ether, and in the other beam light would travel across the ether stream and back.

Ether was thought to be a light-bearing medium affixed to space. Motion of the earth through space was supposed to be analogous to a stream of ether passing by the earth. Light sent upstream and back should take a little longer to make the round trip than light sent across stream and back the same distance. The time delay comes in especially when the light is traveling upstream. Its speed was supposed to be slowed in this "headwind" of ether.² Michelson and Morley obtained a negative result or much less than was expected; there seemed to be no difference in time.

Einstein assumed that there was no ether³ and made his famous postulate that the speed of light c is a constant, that its measured value would come out the same in a moving laboratory as in a still laboratory. It is a little too lengthy to give the details of the strange results this postulated condition would produce.

To untangle those strange results Einstein reasoned that the meter sticks used in the two laboratories had to have different lengths and the watches had to be running at different rates. That is how time dilation and length contraction came into his theory.

B. Relative Length and Time

According to Einstein's special theory of relativity, therefore, neither length nor time (it would be better to say "duration", not "time") are absolute. Length and

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time are relative, i.e. they depend on relative velocity with respect to the observer. Length is supposed to contract in the direction of motion; and time or, rather, any physical process, is supposed to run slower in a body that is moving with respect to the observer. These presumed relativistic effects are referred to as *length contraction and time dilation*.

According to that theory, the amount of contraction or dilation is negligibly small except for speeds that are very great, approaching the speed of light. Hence the applications are restricted to electrodynamics where charged particles may travel with speeds approaching the speed of light. These speeds are much higher than the speeds one ever expects to achieve with rockets.

But electrons do move with speeds of this magnitude in particle accelerators such as the betatron. Special theory of relativity equations are useful in the design of those devices but give no insight into the actual nature of the electrons, and do not provide answers to some problems in electrodynamic radiation.

C. Beneficial Concepts of Special Relativity

According to special theory of relativity the mass of anything is not a constant. Mass m increases with speed v in accordance with the equation

$$m = m_{0} (1 - v^{2}/c^{2})^{-\frac{1}{2}}$$
(1)

where m_{\circ} is the rest mass and c is the speed of light in a vacuum (where light speed is greatest). Note that the relativistic mass m becomes infinite as its speed reaches the velocity of light. The velocity of light c is thus the limiting speed; no mass or energy can travel faster than c.⁴

This increase in mass with speed seems to check with experiment. At least the ratio of mass to charge of the electron seems to increase in the betatron and the other accelerators. The charge of the electron is thought to remain constant. The mass increase shows up as the increase in this ratio. It is the ratio that appears in the design equations. But the increase can be checked experimentally only for charged elementary particles; and there may be another explanation.

The relativistic mass m in Equation (1) is sometimes referred to as the *transverse mass*. It is related to motion of the electron in circular orbit. That motion has acceleration which is toward the center, transverse to the motion along the circle. In order to condense the notation the factor in Equation (1) is replaced by the Greek letter gamma. That is,

$$\gamma = (1 - v^2/c^2)^{-\frac{1}{2}}$$
(2)

In that notation the transverse mass

$$m = \gamma m_0 \tag{3}$$

A surprising development in relativity is that for straight line motion the mass is different from that of transverse mass. It is given by

$$m = \gamma^3 m_0 \tag{4}$$

This relativistic mass is called the *longitudinal mass*. It takes more force, according to special relativity, to accelerate a mass in a straight line (longitudinally) than to produce an equal acceleration in uniform circular motion. This is because the longitudinal mass, for that same particle, is greater than its transverse mass.

From his special theory, Einstein also deduced the famous equation for the equivalence of mass and energy

$$E = mc^2$$
 (5)

The speed of light $c = 3 \times 10^8$ meters per second. Since the equation contains c^2 it is clear that it does not take much mass m to be equivalent to a very large amount of energy.⁵ For example, a mass of just 0.5 kilograms will produce 4.5×10^{16} joules of energy when substituted into Equation (5), which is a very sizeable amount of energy.

III. Difficulties with the Present Theory of Electrodynamics

In spite of the successes achieved by the special theory of relativity there are nevertheless problems with the approach. *First*, there appears to be a serious logical contradiction in the theory. *Second*, some of the hypothetical conclusions appear to be very unrealistic. *Third*, the theory has failed to provide answers to some basic problems in Electrodynamics, and finally, the theory has been developed from and sustained by particular interpretations of various experiments which may not be the best interpretations.

A. The Twin Paradox

The twin paradox of special relativity illustrates the extent of irrationality to which the theory leads. It is hypothesized that if one baby were to travel away from the earth in some theoretical type of space ship with a speed nearly equal to the speed of light, that he would not age as fast as his twin brother who remained at home. This is based on the concept of time dilation, which says that moving clocks run slower than clocks at rest, biological processes being equated with clocks. When the baby returns many years later from his high speed voyage he will still be a baby whereas his twin brother who remained on earth will be an old man.

This paradox might seem to be a humorous one except that it is implicitly believed by doctrinaire special relativity theorists. A great deal of mathematical manipulation is put forth as justification.

It seems logical to look for the weakness in a theory that leads to such an absurdity. The noted British scientist Herbert Dingle (a well known authority on special relativity who later became convinced of the untenability of the theory) has for years shown a logical fallacy in the special theory of relativity with regard to time dilation.⁶ He has furthermore challenged scientists who are knowledgeable in the field to examine his criticism. No one has satisfactorily refuted his logic; although he sometimes had difficulty in getting a hearing.

Dingle points out that special theory assumes that there is no absolute frame of reference. Motion being relative according to the theory, it is not possible to tell which of the twins is at rest and which is in uniform motion. The so-called moving twin might be at rest while the earth moves away with uniform speed. Obviously, the same clock cannot run both fast and slow at the same time.

Relativity could not tell which twin was aging while the uniform relative speed was in existence (during essentially all of the hypothetical time involved). Dingle's arguments seem to make the twin paradox an absolute contradiction.

B. Lack of Direct Experimental Evidence

There has never been any direct experimental evidence for the length contraction predicted by the special theory of relativity. In his book entitled *Special Relativity*, A. Shadowitz states: "It is an amazing fact that there does not seem to exist any direct or simple experimental verification of the Lorentz-Einstein contraction."⁷

There are several presumed experimental verifications of time dilation. The most direct attempt to verify time dilation was the flying of an atomic clock around the world. It was reported that this clock showed less time lapse than a "fixed" reference clock. That report, however, is apparently not reliable. An eminent scientist, an expert on atomic clocks, has recalculated the "flight round the world" experiment using *all* of the experimental readings which were taken but for some reason not used. He found *no evidence for time dilation.*^{8,9}

C. Energy Being Disregarded

There is as yet no acceptable model for the electron, and many questions remain unanswered. It apparently has a magnetic dipole moment $M = 9.285 \times 10^{-24}$ joules per tesla, but how it gets this magnetic property is anybody's guess. It is supposed to be associated with the electron's "spin" but no one really knows what is spinning, or whether the model of something spinning mechanically is just too crude.

There must be magnetic energy associated with this magnetic dipole moment. An approximate value of this magnetic energy can be computed by assuming that it is the energy of a uniformly magnetized sphere the same size as the electron. The general equation for the magnetic energy W of such a uniformly magnetized sphere can be written $as^{10} W = (M^2/r^3) \times 10^{-7}$. Using the classical radius $r = 2.818 \times 10^{-15}$ meters for the electron and the above mentioned value for the magnetic dipole moment then yields $W = 3.85 \times 10^{-10}$ joules for the electron's magnetic energy.

This is an amazingly large amount of energy compared to the presumed rest energy of the electron. Using for the rest mass of the electron the quantity $m_0 = 9.11$ $\times 10^{-31}$ kilograms and the equation $E = m_0 c^2$ for the electron's rest mass energy one obtains $E = 8.20 \times 10^{-14}$ Joules.

Dividing the magnetic energy by the rest mass energy one sees that the electron's magnetic energy is nearly 5,000 times as large as its rest mass energy. The fact that the theory of relativity completely ignores this magnetic energy is a contradictory situation since special relativity is supposed to account for all of the energy. In this case, however, it has neglected the largest amount of self energy in the electron, if one can assume that there actually is such a magnetic moment and that the electron's classical radius is reasonably meaningful.

D. The Muon Time Dilation Experiment

An experiment that attempts to show time dilation in high speed mu-mesons is usually cited in support of special theory of relativity.¹¹ Mu-mesons are said to be produced by cosmic rays in the upper atmosphere and to move downward with speeds very near the velocity of light. The idea is to count the number and measure the speed of mu-mesons reaching a 3000-meter level in the atmosphere, stop them, and measure their remaining life time. Mu-mesons decay in millionths of seconds. Knowing the number of arrivals at 3000-meter altitude, their life time and speeds one can compute the expected distance of travel before they expire.

A table of expected travel time indicated that only a small percent of the mu-mesons passing the 3000-meter altitude should make it to the ground. The experiment is said to have shown that a much higher percentage reached the ground. The conclusion was that the life time of *moving* mu-mesons was much longer than the life time measured for the stationary mu-mesons (stopped for measurement). That is what relativity predicts.

There are many problems with this experiment. Basically it is a "game of chance." No one really knows enough about particle decay processes to predict the decay of any one mu-meson nor *what physical processes may alter its decay rate.*

There are many extraneous physical processes involved. The mu-mesons come in with greatly different speeds and a speed separating process was included. Iron was inserted in the path to cause enough energy loss so that the mu-mesons (those with a particular spread of speed) would just make it through the iron and stop and die in a plastic scintillator. Many never made it and many overshot it. No origin time was known on any mu-meson, only the stay time in the timing device. Hence the actual life time was not measured. It is also known that radioactive decay rates can be altered by external conditions.¹²

Furthermore, "judgment" factors were necessary to "make allowance for the removal of mesons by collision with atoms in the atmosphere." No allowance was made for other influxes or originations of mu-mesons below 3000 meters.

There are many more questions with the experiment than will be acknowledged or answered in textbook descriptions of this and similar time dilation experiments. The mu-meson experiment may in fact give leads to the causes of decay rather than to the presumed time dilation effects assumed in the special theory of relativity. Also, the fact that the mesons are moving at high speeds in the magnetic field of the Earth may need to be considered.

IV. A New Interpretation of the Michelson-Morley Experiment

James Clerk Maxwell's concept of ether was that of a light-bearing medium affixed to space, but the Michelson-Morley experiment makes that concept less plausible. Einstein discarded all concepts of a lightbearing mechanism. This present paper proposes a light-bearing mechanism which seems to be a natural one and which explains the results actually obtained in the Michelson-Morley experiment.

The light-bearing mechanism is assumed to be the *self-field* of the source charge.¹³ The electrostatic field of the charge carries the waves set up in that field by any acceleration of the charge. It is to be understood that light is an electromagnetic wave and that the term "light-bearing mechanism" applies to all electromag-

netic waves, whether or not they happen to be in the frequency range of optics.

Every electric charge has an electrostatic field. It is well known that when the charge is accelerated it sets up a disturbance wave in that field. It is logical to assume that this electromagnetic wave obeys Maxwell's equations with reference to the frame of reference associated with that source's field. It is a ripple travelling outward in that field. This is the mechanism for the radiation of electromagnetic waves.

With this mechanism the Michelson-Morley experiment should come out the way it did, since the field is associated with the light source. Indeed, from this viewpoint the outcome was a forgone conclusion. There is no relative motion of this light-bearing field with respect to the two arms of the Michelson interferometer (the instrument employed in the experiment). The travel time should be the same in each beam, and thus no length contraction nor time dilation are needed to get the Michelson-Morley results.

V. A Classical Approach to Electrodynamics

At this point a new approach to electrodynamics will be explored which yields the same successful results as the special theory of relativity for the transformation of electrodynamic fields between frames of reference moving with respect to one another with constant velocity. These results, however, will be achieved classically without recourse to the concepts of length contraction, time dilation, and the constancy of the speed of light for all reference frames moving with uniform velocity.

The following set of basic electromagnetic relations will be used to demonstrate that an electric field \mathbf{E}_{f} is *induced* in the "fixed" frame of reference when an elementary charge q (such as an electron) moves with uniform velocity v: MKS or SI or Giorgi's units are used.

$$\mathbf{D} = \boldsymbol{\epsilon} \mathbf{E} \tag{6}$$

$$\mathbf{H} = \mathbf{v} \times \mathbf{D} \tag{7}$$

$$\mathbf{B} = \mu \mathbf{H} \tag{8}$$

$$c = (\mu \epsilon)^{-1/2} \tag{9}$$

$$\nabla \times \mathbf{E}_{\mathbf{f}} = -\mathbf{B} \tag{10}$$

(E and D represent electric effects, B and H magnetic.)

The novel feature introduced into this present theory is the assumption that the induced electric field E_i is *fedback* into the moving frame of reference associated with the moving charge.¹⁴ In picturesque language, the charge "sees" this induced electric field which is superimposed upon its original electrostatic field. The end result is a transformed electric field.

According to the special theory of relativity the charge actually never "sees" this induction. This "blindness" from one frame of reference to the other is supposed to be assured by the length contraction and time dilation in the moving frame of reference as seen by the fixed frame of reference. In this proposed theory, however, it is assumed that there is no length contraction nor time dilation. Under this assumption one would expect the electric field to be the same in both frames of reference. It is customary to denote the fixed frame of reference by S and the moving frame of references by S'. The postulated feedback from the S frame to the S' frame assures that the electric field in the two frames will be identical. It must be noted, however, that only one Sframe can be chosen with respect to the S' frame. This Sframe is the one which contains what might be termed the *ambient* field with respect to which the charge was initially accelerated.

The consequence of this ambient field in the S frame of reference is extremely important and needs to be thoroughly investigated. This is a very different principle from that of the special theory of relativity in which any inertial frame of reference may be arbitrarily chosen as the "fixed" frame regardless of whether or not any force had ever accelerated the charge to the "relative" velocity of the two frames.

There is a physical reason to expect an interaction from the *S* frame to the *S'* frame. When a charge is accelerated by a force there must be, according to Newton's Third Law, a reaction force exerted by the field back on the charge—a feedback phenomenon. Thus an altered electric field must develop during the acceleration which acts back on the charge like an inertial force opposing the acceleration.

In addition to the production of a radiation field by the acceleration of the charge, an induction field is also developed. This induction field is associated with the velocity of the charge and stays with the charge as long as it is in uniform motion with respect to the ambient field of the fixed frame. One would expect this electric field feedback to persist during uniform motion, only in a balanced state such that the net feedback force on the charge is zero.

Having made the assumption that there is no length contraction nor time dilation, one may use the Galilean transformations and eliminate the more involved Lorentz-Einstein transformations. This is encouraging because the Galilean transformations utilize the kind of ordinary addition of length and time that one would physically expect to be correct.

A. Derivation of the Electric Field Transformation

Consider an elementary charge q. In the static case, the electric field, being radial and spherically symmetrical, can be written as the displacement

$$\mathbf{D} = \frac{q}{4\pi r^2} \mathbf{u}_{\mathbf{r}}$$
(11)

where u_r is a unit vector in the radial direction. This equation can also be written as

$$\mathbf{E} = \frac{q}{4\pi\epsilon r^2} \,\mathbf{u}_r \tag{12}$$

since $\mathbf{D} = \epsilon \mathbf{E}$. The assumption is made that in the electrodynamic case the resultant electric field is still radial although not spherically symmetrical, since the field lines, as shall be seen later, are "squeezed" toward the direction transverse to the charge's velocity.

In Figure 1 a charge q is shown traveling with constant velocity \mathbf{v} in the z-direction. Spherical coordinates are utilized. Since the **D** line strength is independent of the azimuthal angle ϕ , one may arbitrarily choose a particular **D** line in the x-z plane with polar angle θ without loss of generality.

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Figure 1. This shows the elementary charge q in uniform motion.

The movement of the **D** lines associated with the charge q produces a magnetic field **H** in the S frame in accordance with the equation

$$\mathbf{H} = \mathbf{v} \times \mathbf{D} \tag{13}$$

from which one obtains

$$\mathbf{H} = \frac{q\mathbf{v}\,\sin\Theta}{4\pi r^2}\,\mathbf{u}_{\phi} \tag{14}$$

Since $\sin \theta = x/r$,

$$\mathbf{H} = \frac{q\mathbf{v}\mathbf{x}}{4\pi r^3} \mathbf{u}_{\phi} \tag{15}$$

Denoting the *z*-component of r as z in the fixed frame and z' in the moving frame, one may apply the Galilean transformation (which, from one viewpoint, is just to say that something is moving at speed v)

$$\mathbf{z}' = \mathbf{z} - \mathbf{v}\mathbf{t} \tag{16}$$

and the relation

$$x^{2} = x^{2} + (z - vt)^{2}$$
 (17)

to Equation (15) yielding

$$\mathbf{H} = \frac{qvx}{4\pi [x^2 + (z - vt)^2]^{3/2}} \mathbf{u}_{\phi}$$
(18)

By use of Equations (8) and (9) this becomes

$$\mathbf{B} = \frac{q \mathbf{v} \mathbf{x}}{4\pi \epsilon c^2 \left[\mathbf{x}^2 + (z - \mathbf{v} \mathbf{t})^2 \right]^{3/2}} \mathbf{u}_{\phi}$$
(19)

Taking the partial derivative with respect to time, setting t = 0 when z = z', and noting that $r^2 = x^2 + z^2$ results in

$$\dot{\mathbf{B}} = \frac{3\mathrm{qv}^2 \,\mathrm{xz}}{4\pi\epsilon \mathrm{c}^2 \,\mathrm{r}^5} \,\mathbf{u}_{\boldsymbol{\phi}} \tag{20}$$

Since $\beta = v/c$, sin $\theta = x/r$, and cos $\theta = z/r$ one obtains



Figure 2. This is a plot of \dot{B} and the associated Ef lines, as discussed in the article. The crosses indicate \dot{B} into the plane of the drawing, the dots, \dot{B} out of it. The arrows indicate the induced Ef lines.

$$\dot{\mathbf{B}} = \frac{3\beta^2 \,\mathrm{E_o} \sin\theta\cos\theta}{\mathrm{r}} \,\mathbf{u}_\phi \tag{21}$$

where the substitution

$$E_{o} = \frac{q}{4\pi\epsilon r^{2}}$$
(22)

has been made to express this in terms of the magnitude E_0 of the original electrostatic field.

An observer (or instrument) in the S frame would "see" this $\dot{\mathbf{B}}$ field. By Maxwell's field equation

$$\nabla \times \mathbf{E}_f = -\mathbf{\dot{B}} \tag{23}$$

Thus the $-\dot{\mathbf{B}}$ induces an electric field $\mathbf{E}_{\rm f}$ which "curls around" it and which is felt in the S' frame. The $\dot{\mathbf{B}}$ field is illustrated in Figure 2 along with the electric field $\mathbf{E}_{\rm f}$ which is induced. This induced field $\mathbf{E}_{\rm f}$ tends to reduce the original field at angles θ near 0 and π while tending to increase the original field at angles θ near 2.

B. A Useful Equation for the Radial Induction Field

Observation of the radial type of symmetry in the field pattern of **B** and **E**_i in Figure 2 leads one to assume that the electric field induction and the resultant electric field are radial during uniform motion of the charge q. Under this assumption one may show, by applying Equation (23) to an infinitesimal loop of area $r d \theta dr$, as shown in Figure 3, that at every point in the field

$$\frac{\mathrm{d}\mathbf{E}_{\mathbf{f}}}{\mathrm{r}\,\mathrm{d}\theta} = \dot{\mathbf{B}} \tag{24}$$

The resultant electrodynamic field at any point will thus be a "superposition" of the original electric field E_{o} and the induced electric field which is "fed-back" onto it. Mathematically this may be expressed as



Figure 3. The integration, used in the text to calculate the electric field fed back, was taken in a counter-clockwise direction around the loop shown by the solid lines. This drawing might be considered superimposed onto Figure 2.

$$\mathbf{E} = \mathbf{E}_{0} + \mathbf{E}_{f} \tag{25}$$

where \mathbf{E}_{0} is the original electric field as given in Equation (12) and \mathbf{E}_{f} is the resultant of the feedback electric field. Since the stages of feedback form an infinite series, as will be seen later, Equation (25) may be rewritten as

$$E = E_0 + E_{f1} + E_{f2} + \dots + E_{fn} + \dots$$
 (26)

or

$$\mathbf{E} = \mathbf{E}_{o} + \sum_{n=1}^{\infty} \mathbf{E}_{fn}$$
(27)

where the vector notation has been dropped.

C. First Stage of Feedback

For the first stage of feedback, one can write from Equations (21) and (24),

$$\int dE_{f1} = 3\beta^2 E_0 \int_0^\theta \sin\theta \,\cos\theta \,d\theta \tag{28}$$

which reduces to

$$E_{fl}(\theta) - E_{fl}(0) = \frac{3}{2}\beta^2 \sin^2 \theta E_0$$
 (29)

where E_A must be evaluated at the angles θ and 0. $E_A(\theta)$ is the value of E_A at some angle θ and thus is a function of θ while $E_A(0)$ is the value of $E_A(\theta)$ evaluated at a particular angle $\theta = 0^\circ$. The value of $E_A(0)$ may thus be termed the reference value of $E_A(\theta)$ where $\theta_i = 0^\circ$ is the reference angle. The reference value of $E_A(\theta)$, $E_A(0)$, is thus a constant and must be equal to some quantity $-\lambda_1 E_0$ where λ_1 may be termed the "diminishing factor" since $E_A(0)$ diminishes the original electrostatic field E_0 at the angle $\theta = 0$. Thus one may write

$$E_{f1}(\theta) = E_{f1}(0) + \frac{3}{2}\beta^2 \sin^2\theta E_0$$
 (30)

or

$$E_{f1}(\theta) = \frac{3}{2} \beta^2 \sin^2 \theta E_0 - \lambda_1 E_0$$
(31)

Note that $E_{f}(\theta)$ will be positive at values of θ near $\pm \pi/2$ and negative for values of θ near 0 and π . Dropping the functional notation one has

$$E_{f1} = \frac{3}{2} \beta^2 \sin^2 \theta E_0 - \lambda_1 E_0$$
(32)

for the first stage of feedback.

D. Second Stage of Feedback

Referring back to Equation (26): $E = E_0 + E_{f1} + E_{f2} + \ldots + E_{fn} + \ldots + E_{f1}$ was the induced field resulting from the motion of E_0 and is solved for in Equation (32). The next step is to solve for the induction field E_{f2} which will be induced in turn by the motion of E_A . One must begin with the equation

$$\mathbf{H}_2 = \mathbf{v} \times \epsilon \mathbf{E}_{f1} \tag{33}$$

which from Equations (8), (9), and (32) can be rewritten as

$$\mathbf{B}_{2} = \frac{1}{c^{2}} \left[\mathbf{v} \times (-\lambda_{1} \mathbf{E}_{0} + \frac{3}{2} \beta^{2} \sin^{2} \theta \, E_{0}) \mathbf{u}_{r} \right]$$
(34)

Noting Equation (22) for E_0 and the relations for $\sin \theta$ and r as given in Equations (15) and (17) one arrives at

$$B_{2} = \frac{qv}{4\pi\epsilon c^{2}} \left[\frac{3}{2}\beta^{2} \left(\frac{x^{3}}{[x^{2} + (z - vt)^{2}]^{5}/2}\right) -\lambda_{1}\left(\frac{x}{[x^{2} + (z - vt)^{2}]^{3}/2}\right)\right] \mathbf{u}_{\phi}$$
(35)

Taking the partial derivative with respect to time, setting t = 0 when z = z', noting that $r^2 = x^2 + z^2$ yields,

$$\dot{\mathbf{B}}_{2} = \frac{qv^{2}}{4\pi\epsilon c^{2}} \left[\frac{15}{2}\beta^{2} \left(\frac{x^{3}z}{r^{7}}\right) - 3\lambda_{1} \left(\frac{xz}{r^{5}}\right)\right] \mathbf{u}_{\phi}$$
(36)

which reduces to the scalar form $a^2 F$

$$\dot{\mathbf{B}}_{2} = \frac{\beta E_{0}}{r} \left[\frac{15}{2} \beta^{2} \sin^{3}\theta \cos\theta - 3\lambda_{1} \sin\theta \cos\theta \right] \quad (37)$$

since $\cos \theta = z/r$ and $\sin \theta = x/r$. Applying Equation (24) to this expression for $\dot{\mathbf{B}}_2$ and integrating as before from angles 0 to θ gives (38)

$$E_{f2}(\theta) = E_{f2}(0) + \frac{15}{8}\beta^4 \sin^4 \theta E_0 - \lambda_1 \left[\frac{3}{2}\beta^2 \sin^2 \theta E_0\right]$$

Using the same reasoning as before, $E_{f_2}(0)$ must diminish the original field E_0 at angle $\theta' = 0$ by some factor λ_2 where λ_2 will be less than λ_1 in magnitude. This will be true since the field inducing E_{f_2} is less than the field inducing E_{f} . Thus the final result for the second stage of feedback is

$$E_{f2} = \frac{15}{8} \beta^4 \sin^4 \theta E_0 - \lambda_1 \left[\frac{3}{2} \beta^2 \sin^2 \theta E_0\right] - \lambda_2 E_0 \quad (39)$$

E. Additional Stages of Feedback

The next step of course is to solve for the remaining "feedback terms" of Equation (26). Going through the same procedure as before and noting that E_{f_3} will be induced by E_{f_2} one obtains

$$E_{f3} = \frac{105}{48} \beta^{6} \sin^{6} \theta E_{o} - \lambda_{1} \left[\frac{15}{8} \beta^{4} \sin^{4} \theta E_{o} \right] - \lambda_{2} \left[\frac{3}{2} \beta^{2} \sin^{2} \theta E_{o} \right] - \lambda_{3} E_{o}$$
(40)

Combining the expressions for E_{f_1} , E_{f_2} , and E_{f_3} and substituting into Equation (26) for the first four terms of the infinite series yields

$$E = E_{o} \left[1 + \frac{3}{2} \beta^{2} \sin^{2} \theta + \frac{15}{8} \beta^{4} \sin^{4} \theta + \frac{105}{48} \beta^{6} \sin^{6} \theta \right]$$
$$-\lambda_{1} E_{o} \left[1 + \frac{3}{2} \beta^{2} \sin^{2} \theta + \frac{15}{8} \beta^{4} \sin^{4} \theta \right]$$
$$-\lambda_{2} E_{o} \left[1 + \frac{3}{2} \beta^{2} \sin^{2} \theta \right] - \lambda_{3} E_{o}$$
(41)

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Figure 4. This shows the spherical coordinates used for the integration to find the total flux of the electric field. The element of area is of magnitude $2\pi a^{2}\sin\theta \ d\theta$. Here $ad\theta$ is the width of the zone which forms the element of area, as shown; the radius of the sphere is a. Note that the electric field, being radial, is everywhere normal to the spherical surface.

Observation of this expression makes it clear where the series is heading since the term in each of the brackets is the binomial expansion for the quantity $(1 - \beta^2 \sin^2 \theta)^{-3/2}$ When the feedback is completed the expression (41) will become (42)

$$E = E_{o} \left[\frac{1}{(1 - \beta^{2} \sin^{2} \theta)^{3/2}} \right] - \sum_{n=1}^{\infty} \lambda_{n} E_{o} \left[\frac{1}{(1 - \beta^{2} \sin^{2} \theta)^{3/2}} \right]$$

which further simplifies to the expression

$$E = E_{o} \left[\frac{1 - \lambda}{\left(1 - \beta^{2} \sin^{2} \theta\right)^{3/2}} \right]$$
(43)

where $\lambda = \sum_{n=1}^{\infty} \lambda_n$.

F. The Resultant Field and Conservation of Flux

The resultant electric field of a moving charge q as seen by an individual in the fixed frame of reference is thus given by Equation (43). The only task remaining is to solve for the constant λ which is the total sum of the diminishing factors λ_n . This can be done by noting that the total charge does not change with the motion; it is said to be invariant with velocity.¹⁵ (At least, that seems commonly to be taken for granted. It is true that Ritz's proposed system of electrodynamics might have been interpreted otherwise; but a discussion of that would be out of place here.)

The total flux, then, of the electric field must be constant; in mathematical terms

$$\iint \mathbf{E} \cdot \mathbf{n} \, \mathrm{dA} = \frac{\mathbf{q}}{\epsilon} \tag{44}$$

The integral is to be taken over a surface enclosing the charge. dA is an element of that surface, and n a unit vector normal to it. E is the (total) electric field (at any velocity) as given in Equation (43).

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Any surface would do; but a spherical one, its center at the charge, is convenient. The E and n are in the same direction, so the vectorial notation is no longer needed. The Equation (44) becomes

$$\iint E_{o} \left[\frac{1 - \lambda}{\left(1 - \beta^{2} \sin^{2} \theta\right)^{3/2}} \right] d\mathbf{A} = \frac{q}{\epsilon}$$
(45)

It is convenient to take the polar axis in the direction of motion; then θ is the polar angle. The integration is quite simple, with the help of spherical coordinates, as in Figure 4. E_0 as given in Equation (22) is substituted; and the integration comes to the intermediate stage

$$\frac{q(1-\lambda)}{2} \int_{0}^{\pi} \int_{0}^{\sin\theta} \frac{\sin\theta \, d\theta}{\left(1-\beta^2 \sin^2\theta\right)^{3/2}} = q$$
(46)

Since

$$\int_{0}^{\pi} \frac{\sin\theta \, d\theta}{\left(1 - \beta^{2} \sin^{2}\theta\right)^{3/2}} = \frac{2}{1 - \beta^{2}}$$
(47)

 λ must then be equal to β^2 in order for the total flux of E to be conserved. The final expression for the total field can therefore be written as

$$\mathbf{E} = \frac{q}{4\pi\epsilon r^2} \left[\frac{1-\beta^2}{\left(1-\beta^2 \sin^2\theta\right)^3/2} \right] \mathbf{u}_{\rm r}$$
(48)

A plot for the cross section of this electric field equation is given in Figure 5 for a velocity equal to 94% the speed of light c (which makes $\sigma = 3$). Note that the electric field lines have been shifted up toward the direction transverse to the direction of motion, which means a decrease of E lines in the direction parallel to the motion,¹⁶ as compared with the pattern for a stationary charge.

VI. Conclusion

Equation (48) is the same solution one would obtain using the special theory of relativity for the electric field seen in the fixed frame of reference for the case of a charge q traveling by with uniform velocity.¹⁷ The remarkable thing about this new theory is that the assumptions of length contraction, time dilation, and constancy for the speed of light c were not necessary. *Thus a classical foundation has been established for electrodynamics.*

Acknowledgement

The assistance of Kenneth Moses in the preparation of the figures is gratefully acknowledged.

References

¹Lorentz had used the equations earlier, on different grounds. And Voigt had introduced them yet earlier, in 1887, as an algebraic trick. See O'Rahilly, Alfred 1965. Electromagnetic theory. Dover. (Originally published by Longmans, Green, and Co., in 1938, as Electromagnetics). Vol. 1, pp. 324-327.

²There may, though, be fallacies in the discussion of this experiment commonly given in the textbooks. For one thing, it jumbles ballistic notions, such as time of flight, with interference, a wave phenomenon. Also, if the ether wind be admitted, things become complicated: wave fronts are skewed upon reflection, angles are no longer equal, etc. See O'Rahilly, *Op. cit.*, pp. 258-259, 336-339, and 439 (Reference 1). It may be that there has never been an adequate analysis of the experiment.





Figure 5. This shows the effect of the motion on the electric field lines. Part (a), the upper part, shows the field lines for the charge at rest. Part (b), the lower part, shows the lines for the same charge moving at a velocity 0.94c, so that $\beta = 0.94$ and thus $\sigma = 3$.

^sIt appears, though, that Einstein was of different opinions about the ether at different times. See Jánossy, L. 1971. Theory of relativity based on physical reality. Akadémiai Kiadó, Budapest, pp. 48-50. The author cites an article of Einstein's which is not generally known. ⁴The "tachyons", hypothetical particles moving at speeds greater than that of light, about which so much was written a year or two ago (see, e.g., Kreisler, Michael N. 1975. Faster than light particles —do they exist?, *The Physics Teacher* 13(7):429-434) seem to have gone out of fashion.

^sThis mass, incidentally, seems to be the transverse one. Indeed, the longitudinal mass seems often to be something of an embarrassment. See, e.g., Brown, G. Burniston 1958. The unification of macroscopic physics, *Science Progress* XLVI(181):15-29. See especially the footnote on p. 26.

^oDingle, Herbert 1972. Science at the crossroads. Martin Brian, and O'Keeffe, London.

'Shadowitz, A. 1968. Special relativity. W. B. Saunders, p. 168.

*Essen, L. 1977. Atomic clocks coming and going, *Creation Research Society Quarterly* 14(1):46.

⁹Indeed, even if the results claimed were established, they may not prove much. Even a pendulum clock, moving around the Earth, would run at a slightly different rate from one which was kept in position, because the effective acceleration of gravity would be a little different. Again, the moving clock was moving through the magnetic field of the Earth; that might have had some effect.

¹⁰Barnes, Thomas G. 1975. Earth's magnetic energy provides confirmation of its young age, *Creation Research Society Quarterly* 12 (1):11-13. (Corrected formulation.)

¹¹French, A. P. 1968. Special relativity. The M. I. T. Introductory Physics Series, W. W. Norton and Co., New York, pp. 97-104.

¹²DeYoung, Don B. 1976. The precision of nuclear decay rates, Creation Research Society Quarterly 13(1):38-43.

¹³This is something like an idea which Faraday suggested about 1846. See Dingle, Herbert 1960. The Doppler effect and the foundations of physics II, *British Journal for the Philosophy of Science XI*(42): 113-129. See especially pp. 115-117. Apparently Faraday never followed the idea up; and Maxwell, when he came to follow up some of Faraday's ideas, gave this one a rather different aspect.

¹⁴The notion of feedback is much used by electronic engineers. It means, in the most general terms, that an effect somehow acts back on the cause. How that applies here will be seen later.

¹⁸Schwartz, Melvin 1972. Principles of electrodynamics. McGraw-Hill, New York, pp. 121 and 122.

¹⁶One might say that the field lines are contracted in the direction of motion. Is it possible, then, that this contraction of field lines came to be ascribed to the actual objects?

Incidentally, the name FitzGerald is often associated with the supposed contraction. However, what FitzGerald envisaged was apparently an expansion, transversely to the direction of motion. See Dingle, Science at the crossroads, pp. 162-164. (Reference 6).

¹⁷Jackson, J. D. 1975. Classical electrodynamics. Second Edition. John Wiley and Sons, p. 555.

(*Editor's Note:*) If some readers are surprised at finding an article on a topic in theoretical and mathematical physics in this creationist publication, the reasons, mentioned on page 197 of the *Quarterly* for March 1976 under "Further Editor's Comment", might be repeated. There are, moreover, two other points.

In the first place, electromagnetic theory affects practically all of physics. Surely it has to do, for instance, with the decay of radioactive materials, although the connection may not yet be well understood. Thus a better understanding of electrodynamics might help to throw some light onto the behavior of such isotopes as carbon 14, and help in solving problems having to do with the use, or attempted use, of isotopes in determining the ages of things.

The second point is rather different. I have seen writings in which the authors hoped to apply formulae from the theory of relativity to many questions, some from theology as well as from natural science. Sometimes, for instance, the thought has been that the dilation of time, considered well established as a universal happening, might be the key to reconciling a Biblical chronology with the long times proposed by uniformitarians. If, then, relativistic notions are not so well established after all, or if they are only so many tricks to be used in solving electrodynamic problems, those intending to make such attempts should know the facts of the case. Otherwise, they might find themselves leaning on a broken reed.)

ATOMIC CLOCKS COMING AND GOING[†]

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The results obtained by Hafele and Keating¹ are so important that they merit a more critical examination than that made by W. B. in Nature.² He gave the final result that the clocks lost 59 \pm 10 ns^{**} during their eastward flight and gained 273 ± 7 ns during their westward flight. These results correspond to frequency changes of -25×10^{-14} and 94×10^{-14} respectively, with limits of error of 4×10^{-14} and 3×10^{-14} , and indicate the use of clocks of unusually high stability. The time difference from standard time of the four clocks used are shown graphically in Figure 1 of the authors' paper; and it is clear that they varied in frequency by amounts which are normal for such clocks. In particular three of them suffered changes of about 1 part in 10¹² during the eastward flight which persisted after the flight. It is necessary to know when these changes occurred before any conclusions can be drawn about the possible changes caused by the flight itself; but by a fortunate chance the persistent changes are in opposite directions for different clocks and on the average nearly cancel out. If we can assume with the authors that they occurred at the mid-point of the flight, the results for the individual clocks, as read from the graphs are then as shown in Table 1.

In view of the differences between the results for individual clocks, the mean value is of doubtful significance but there is an indication of equal and opposite time differences for the two directions of travel.

In Figure 2 of the authors' paper the measurements are reproduced for only 35 hrs before the eastward flight and those for only 25 hrs are used, before and after each journey. This seems to be a strange thing to do because it is well known that such clocks can vary by 1 part in 10^{12} when averaged from day to day. The time differences obtained from this graph are changed from -132 ns to -66 ns and from +134 ns to +205 ns. If the whole of the 35 hrs observation were used it is clear from Figure 2 that the result for the eastward journey would be further reduced to about 30 ns. The result depends markedly on the period of observation used, and one would expect the most reliable value to be that in Table 1 based on the full period. The authors then proceed to make a statistical analysis of the frequency comparisons made between the clocks, to obtain their final results. No details of these comparisons are given, but the analysis is based on the assumption that the frequency variations are random in nature, which appears to be unlikely and is not in accord with my own experience.

Table 1. Time difference from standard time during the journey round the Earth. Unit = 1 nanosecond.

clock no.	eastward flight	westward flight
120	- 80	+180
361	- 350	+ 55
408	0	+ 300
447	- 100	0
mean clock	-132	+134

In their theoretical discussion³ the authors ignore detailed and fully documented criticisms of Einstein's relativity theory which have been made and have not been refuted.^{4, 5} I suggest therefore that the theoretical basis of their predictions needs careful scrutiny and that the experimental results given in their paper do not support these predictions.

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This critical note was writtin about the time that the experiment discussed in it was published, and submitted to a journal which had published something about the experiment; but the note was rejected. It is published here in the belief that the only way to arrive at the truth in scientific matters is by free and open discussion. (Editor)

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^{**&}quot;'ns" means "nanosecond", a unit of 10° second. (Editor)

KAMES, ESKERS, AND THE DELUGE

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Kames and eskers do not seem to be forming in modern glacial deposits, and the origin of these features is a baffling problem for geologists. A new concept of the drift is suggested by a possible process of rock disintegration during uplift of the continents at the end of the Deluge. Expansion effects of this disintegration process can account for the formation of kames and eskers. Many of their features fit this explanation, while the same features are problematic in terms of the Glacial Theory. The concept of the formation of drift by disintegration may help solve some problems in creationist geology.

Were Kames and Eskers Formed by Ice?

Kames and eskers are familiar mounds and ridges in places where a layer of unconsolidated sand and gravel mantles the countryside. Striking examples of kames occur in the region of Kitchener, Ontario. Chikopee and Doon Hills are prominent kames. The long slopes on Chikopee Hill make it an excellent ski area in winter.

Doon Hill is a large kame near the 401 highway, with a TV tower at the summit. The Baden Hills, a few miles west of Kitchener, are a group of remarkably symmetrical kames about two hundred feet high. Radio transmission towers are mounted on the highest hill. The Baden Hills are probably the best known examples of kames in Ontario, and they have been described by Karrow as "moulin kames."¹

Kames are often associated with, or grade into eskers. The eskers are prominent winding ridges of gravel and sand. See Figure 1. J. K. Charlesworth refers to both kames and eskers as "osar," and refers to the problem of their origin as "one of the most thorny of glaciological problems."² Rejecting several early hypotheses, Charlesworth wrote:

The exclusion of all these hypotheses still leaves much room for uncertainty which research on existing glaciers has done little to dispel: modern accumulations resembling osar in appearance and structure are singularly few. The investigator is baffled at every turn³

Kames and eskers are thought to have been formed during the Ice Ages by deposition of debris from melting ice. Investigators have looked for ridges and mounds among the moraines of present-day glaciers, and have claimed some of these structures are eskers in the process of formation.

In 1958, J. C. Stokes reported an esker-like ridge in front of the retreating Svartisen ice cap in north Norway. Composed of sand, boulders and rock flour, the ridge was one to two meters high, and was formed in a tunnel beneath the ice. Embleton and King reported:

In tunnels beneath the glacier, debris was found piled up against the walls, ready to form ridges as the ice melted. The process would form small unstratified esker-like ridges, similar to genuine eskers in that they form in a subglacial tunnel, but unlike them in their lack of stratification.⁴

W. V. Lewis, looking for esker-like ridges among the deposits of glaciers in the Rondane district of eastern



Figure 1. This is an aerial view of a typical esker, a few miles west of Baraboo, Wisconsin. Because of the rugged topography of the esker, it remains wooded, although the surrounding country is intensively cultivated.

Norway, found a ridge 120 feet in length, which he claimed was an esker.⁵

When such reports are considered in view of the scale of many eskers, there seems to be hardly any comparison. Eskers in Maine extend 150 miles in length.⁶ Those in Finland are even longer, and are elevated 80 meters above the surrounding drift. J. J. Donner reported:

Many parts of Finland are crossed by long continuous eskers or broken series of esker ridges . . . The well-developed eskers in central Finland reach up to 40 m - 60 m, in some places 80 m, above their surroundings; and their material consists of wellsorted glaciofluvial material.⁷

Modern glacial deposits which have been identified as eskers do not seem to have the internal structure of typical kames and eskers of the drift. The presence of cross stratification has not been reported. Although streams flowing from glaciers do form moraine ridges, e.g. at Breidamerkurjökull, Iceland,⁸ it is doubtful that true kames and eskers are actually formed by glaciers at the present time.

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A New Concept of the Drift

The glacial theory of the drift would lead geologists to expect kames and eskers would be in the process of formation in glaciers and ice-sheets at the present time. The difficulty in finding comparable structures in the process of formation is only one of many problems in the glacial theory.

Many creationists remain unconvinced that there really was an Ice Age, and that the Glacial Theory is the correct interpretation of the drift phenomena. Some objections to the theory have been cited in a recent article.⁹

It is incumbent on those who object to the Glacial Theory to suggest an alternative explanation of the drift. This article outlines a mechanism of kame and esker formation, in the context of the Noachian Deluge rather than Ice Ages.

A new concept of the drift is suggested by a possible geologic effect of uplift of the continents at the end of the deluge. Rapid release of pressure caused disintegration of surface rocks, forming the pattern of cross stratification in the sand of the drift. A proposed mechanism of shattering was described in another article.¹⁰

In this new interpretation, the drift is the product of a disintegration of surface rocks during elevation of the continents at the end of the Noachian Flood. This disintegration affected rocks of various types, and the composition of the drift would thus reflect that of the original surface rocks.

Both igneous and sedimentary rocks are found mantled with drift. Along the border of the Canadian Shield in Ontario, a change in the composition of the drift is apparent, reflecting the change in the kind of bedrock present below. This is typical of the drift in other regions, and is what we would expect if the drift originated by disintegration.

So that this new concept of the drift can be considered in historical perspective, earlier creationist thinking about the drift is reviewed.

Creationist Thinking on the Drift

The earliest geologists were creationists, and the problems they tried to solve were much the same as those creationists face today.

French paleontologist Georges Cuvier supposed the drift was the deposit of the Noachian Flood. This view was also upheld by William Buckland, who cited evidence from bones found in caves and the drift of England.

Charles Lyell favored the iceberg theory of the drift, which to many appeared to fit in with the Noachian Flood. However these views were replaced by the Glacial Theory beginning about 1840, and the Geologic Time Scale became "frozen" in about the form in which it is presented today.

Creationist geologist George McCready Price spearheaded the attack on the doctrine of uniformitarianism in the present century. He denied that the flood could have followed the Ice Age, an interpretation favored by George Frederick Wright. Price has written:

Of one thing I am certain: the Flood was not due to the melting of a great continental ice-cap. The theory of an "ice-age" was invented as a sort of mental buffer, an intellectual shock absorber, in order to make the transition from the fossil world to the modern condition of things seem less abrupt, less catastrophic,—and this after almost all the fossils had already been strung out in a long series reaching back almost to the dawn of eternity... when we adopt correct scientific methods of studying the rocky record for the world as a whole, we shall cease to be troubled with any "glacial nightmare." Certainly we shall not invoke the melting of this imaginary ice-cap to explain the Flood. Several other explanations are more probable.¹¹

Following the views of George McCready Price, Alfred Rehwinkel in his book, *The Flood*, devoted a chapter to objections to the glacial theory. He suggested that the drift had been deposited by currents of the deluge rather than ice-sheets.¹²

Both the iceberg theory and the idea of diluvial currents distributing the drift encounter difficulty with the fact of the similar composition of the drift and the underlying rocks. There seems to be no reason for this correspondence, unless it has been formed from the rocks below.

While the drift is similar in composition to the rocks below, it differs greatly in its unconsolidated condition and structure. To many creationists it seems that if the deluge was responsible for the "solid" sedimentary rocks, the drift above must be attributed to some other kind of action.

Ice-sheets, it is claimed, are capable of eroding bedrock and depositing debris similar in composition above it when the ice melts away.

Byron Nelson in *The Deluge Story in Stone* accepted the Ice Age interpretation of the drift.¹³ Whitcomb and Morris supported this view, with some reservations, in *The Genesis Flood*.¹⁴.

Adoption of the Glacial Theory means all the problems and weaknesses of this theory are included in a creationist framework of geology. Many additional problems are created.

For example, condensing the duration of the Glacial Period from about a million years to say, about 2,000 years involves a reduction by a factor of 500.

R. F. Flint has documented the required amount of transport of drift by motion of the ice-sheets: as a typical example, he noted: "Stones from Ontario have been carried as much as 1,000 km to positions in Missouri."¹⁵

A creationist view of the Ice Age, presumably, would require this amount of movement in about 2,000 years. The ice-sheet would thus have to move at the speed of above five feet per day. This exceeds the rate of flow of many mountain glaciers on steep slopes, but there is no downhill gradient aiding the movement of ice towards the south. In fact, glacialists believe the weight of the ice in Northern Ontario may have depressed the crust of the earth by about 1,000 feet or so, and the ice would then have to flow *uphill* to Missouri!

At present, some creationists believe in a short, rather catastrophic Ice Age following the deluge, and others, probably a minority, attempt to explain the drift and its landforms in terms of currents of the Flood.

Kames, eskers, and other features are explained as giant ripples or deposits of violent torrents. John Cunningham has suggested that this point of view succeeds "at least as well as does the ice age hypothesis."¹⁶

However, currents of the Flood would likely have deposited the erratic boulders and gravel *underneath* the finer sediments, rather than on top. The drift seems to be out of its proper sequence, in this diluvial theory.

The proposed disintegration theory explains the formation of the drift in place, and does not involve long transport of innumerable rounded boulders and erratics. The material would be in proper position on the surface. And similarity to the bedrock is what would be expected in a process of rock disintegration.

In some regions the thickness of drift is of the order of thousands of feet, and this indeed involves problems for any transportation theory, either by ice or water.

Kames and Eskers: Expansion Effects

It is clear that the Glacial Theory is not altogether satisfactory as the final answer to problems posed by the drift, and there is much to be desired in the alternative diluvial theory as well.

In the theory of disintegration due to release of pressure as the origin of the drift, the kames and eskers may be quite neatly explained as the effects of expansion. During disintegration, it is likely that some expansion would occur, causing limited movement within the drift.

Lateral expansion over a wide area could result in quite a considerable mass of drift being pushed across the bedrock, striating the surface. Consider a possible effect of expansion during the disintegration of bedrock, amounting to 4% increase in volume. Suppose the surface rocks were disintegrated to a depth of 100 feet. Then the resulting vertical uplift would be four feet.

But the lateral effects of the expansion must also be accommodated. In an area of one mile radius, the drift would tend to be pushed into the surrounding area, so that the radius of the region it covered would be increased by more than 100 feet.

Of course, friction and resistance from surrounding drift, also expanding, would limit lateral movement. In places, then, it is to be expected that mounds and ridges would be pushed up. It is suggested that kames and eskers have resulted from such movements, caused by expansion during rock disintegration at the time of the Deluge.

Some Familiar Analogies

A common phenomenon caused by expansion of water upon freezing provides an analogy. Ice cubes formed in a rigid metal tray often have surfaces pushed up into conical mounds. These may be quite pointed, and the little mounds of ice resemble some kames composed of drift.

A variety of mounds and ridges of ice may be produced by freezing water in shallow trays with rigid walls. Though on a much smaller scale, it seems that the principles causing the formation of mounds and ridges in such experiments would also apply during a shattering and disintegration of rocks on a much greater scale. Ice forms on the surface of water, and tends to expand laterally. The restriction of lateral movement by the rigid walls of the container results in upheaval of the surface. In some lakes, pressure ridges analogous to eskers may be formed due to similar causes.

In the theory of rock disintegration, shattering would have proceeded from the surface downwards. A layer of sand and gravel expanding over the original volume would have been produced. This mantle of drift would behave much like the freezing water in a rigid tray, and where movement was restricted laterally, mounds and ridges would be pushed up. These would resemble the structures formed in surfaces of ice freezing under various kinds of restricted conditions.

An example showing the considerable pressure that may result from expansion of water during freezing, is familiar to some unfortunate people: failure to add antifreeze to a car engine cooling system has resulted in many a cracked engine block.

Another analogy with the effect of expansion during a disintegration origin of the drift is provided by a cake baking in an oven. The surface of a cake may be formed into mounds and ridges, because as the cake batter is heated, little bubbles of carbon dioxide are formed, and the cake expands in conditions restricted laterally by the walls of the baking pan.

Signs of Uplift in Kames and Eskers

The internal structure of kames and eskers provides evidence for a disintegration-expansion theory of origin. The material comprising kames and eskers is sand and gravel, and the pattern of cross stratification is evident in the sand.

The reality of a disintegration origin of cross stratification could be given strong support from direct experiments involving the rapid release of pressure on rocks. Such experiments on the nature of cross stratification present a major challenge to creationist scientists today.

The structure of kames and eskers indicates upthrust from below, as anticlinal structures are commonly present. This has often been interpreted as the effect of melting of side-walls of ice. The sides of eskers are supposed to have slumped. Flint described the feature, observed in many eskers in Connecticut:

Transverse sections of every esker suitably exposed in eastern Connecticut, as well as sections of scores of eskers described from other localities, invariably exhibit irregular bedding paralleling the side-slopes of the esker. This bedding is definitely attributable to slump attendant upon the melting away of the retaining walls of the ice. Slumps made by artificial excavations on Connecticut eskers kept under observation develop a structure identical with the above. The side-slopes, controlled thus by the angle of rest of the material involved, range in 20 of these eskers from 18 ° to 30 °, with an average of about 20 °.¹⁷

Other glacial geologists have interpreted anticlinal structures within eskers as evidence that the eskers have been thrust up by pressure from below. It has been supposed that eskers are compressional features, that were pushed up by the weight of the ice on either side.¹⁸

In terms of the disintegration-expansion hypothesis, the anticlinal structure of kames and eskers is due to the warping of the drift by upthrust, associated with lateral pressures of the drift on either side of the kame or esker. Kames are formed when the stress is radial, and eskers occur along the intersection of two opposing bodies of drift.

Some eskers contain several successive anticlinal structures of piled-up drift. These are referred to as "multiple eskers."¹⁹

The strata some tens of feet below eskers may show no signs of disturbance, and these eskers may have formed before the plane of rock disintegration had penetrated to the level of these undisturbed layers.

Conceivably the shattering process would have proceeded from the top downwards, in successive stages, forming cross stratified sand and gravel. There would likely have been movement, in some cases, before the underlying rock disintegrated. This would result in a low profile, well defined esker, with greatly disturbed material at the surface. The underlying drift would remain intact.

Conversely, expansion and movement of underlying drift might cause uplift of undisturbed layers of drift, resulting in a large, wide esker ridge. The disturbed strata would be deep below the esker.

Evidence for Disturbance

Eskers are often hummocky and irregular. The drift within eskers is often faulted and distorted. This distortion would result from stresses built up due to expansion during formation of the drift by disintegration.

Some sections of eskers may have the pattern of cross stratification in the sand obliterated due to movements, and material without stratification is described as "till."

An interesting feature of some eskers in Denmark is the presence of vertical "clay walls." This feature is described by Hansen:

The horizontal sequences of gravel and sand in the eskers are in Denmark called alpha-layers, and they form the so-called piled-up eskers. Another group of eskers is characterised by a central vertical clay wall (moraine clay), flanked by steeply dipping, cross-bedded gravel and sand. These sequences of gravel and sand are called beta-layers, and together with the clay wall they form a clay-wall or a squeezed-up esker. Sometimes a combination of a clay wall and beta-layers occurs in the lower part of an esker, and horizontal alpha-layers may be present in the upper part of the same esker.²⁰

This mysterious "clay-wall" may represent a disintegration feature, where a vertical crack or fault was present in bedrock. Vertical structures known as clastic dikes are not uncommon in the drift.

Some movement both vertically and horizontally within eskers might be expected in the disintegrationexpansion hypothesis. An indication of vertical movement associated with eskers and kames is the fact that the height of the drift on either side of eskers may vary considerably. The writer has seen variations in the elevation of drift on either side of eskers near West Montrose and a few miles east of Mount Forest, On-



Figure 2. These are some profiles of the Baden Hills, mentioned in the text. The chain of peaks shown here extends for about 1,100 yards. The one shown at the top is the most easterly; the one at the bottom the most westerly. Note that the land to the south-east of the hills is raised more than that to the north-west. The significance of this inequality is discussed in the text.

tario. The differences are commonly about 50 feet. See Figure 2.

Similar differences in elevation of the drift occur in the vicinity of kames. Depressions such as kettles are common near kames and eskers.

Embleton and King illustrated cross profiles of an esker near Reflection Lake, Baffin Island. The length of the esker under study was about 800 meters. An average difference in elevation of the drift on either side of the esker, from 20 profiles, is nearly five meters.²¹

Vertical movements due to expansion may have caused such differences in the height of the drift on either side of kames and eskers, but variations in the level of the drift would not be expected if eskers had simply been let down on the surface of the drift from melting ice-sheets.

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According to the disintegration-expansion theory, the tops of eskers were contorted and faulted by movements during their uplift, but some of this evidence for disturbance might have been mistaken for frost effects. For example, while describing the internal structure of an esker in Norfolk, England, R. C. West wrote: "The uppermost parts of the esker gravels are much disturbed by cryoturbation."²²

Composition of Eskers

The idea of disintegration and expansion causing eskers would lead one to expect that the eskers would resemble the content of the drift and bedrock in the immediate vicinity.

The glacial river hypothesis, on the other hand, would require that there was much movement of the drift along the course of the esker, in the river flowing within the ice-sheet.

In fact the gravel within eskers does not seem to have been transported to the extent which would be expected if the eskers were the deposits of glacial rivers.

Chapman and Putnam stated that the longest esker in Southern Ontario stretches from Biddy Lake, near Colborne, to beyond Beaver Lake. That esker crosses the edge of the Canadian Shield, and it is thought that the direction of flow of the glacial stream which produced the esker was from the northeast to the southwest. Thus, it is to be expected that Precambrian rocks would be present within the esker for a considerable distance south of the Shield boundary, that had travelled within the glacial river. Observations do not support the glacial interpretation. Chapman and Putnam reported:

The stream that laid down this gravel flowed to the west crossing the limestone border at Beaver Lake. On examining this gravel in the esker we were surprised to learn that, although not one limestone pebble could be found north of it, the gravel a scant mile or two over the boundary was approximately three-quarters limestone.²³

The content of the esker gravel changed abruptly over the border between the limestone and the Canadian Shield. This does not confirm the hypothesis of a river in the ice-sheet having formed the esker, but it does support the idea of disintegration, and the esker resulting from uplift due to expansion during the formation of the drift.

The composition of the drift in some areas may not resemble the bedrock below, if the surface rocks which were disintegrated overlaid rocks of another type. In such cases the drift may seem to have been transported.

Boulders within kames and eskers may be portions of original bedrock left intact, as for example masses of bedrock within an esker in Southern Alberta reported by A. MacS. Stalker.²⁴

Several erratic boulders of granitic rock occur on the slopes of the Baden Hill kames near Kitchener, Ontario. One such boulder was partly disintegrated in such a way that a gradual transition from rock to sand occurred, and the sand was continuous with the sand comprising the kame. It seems that such disintegrated boulders could hardly have been carried great distances by ice-sheets.

Striations on Boulders and Bedrock

Striations on boulders in the drift have long been cited as evidence for the action of moving ice, but movements of the drift due to expansion would also cause grooves and scratches on boulders. These are not found on all the boulders, and seem to be limited to definite horizons.

Similarly striations on bedrock underlying the drift would be expected as an effect of disintegration. Ron Plewman, engineer at the Canada Crushed Stone plant near Dundas, Ontario, told me of some observations on these striations a few years ago. At this limestone quarry, a layer of drift several feet thick must be removed before quarrying. As the drift cover was excavated, long striations were found on the surface of the limestone. Further excavations invariably located a large boulder resting on bedrock at the terminus of the groove in the limestone.

In the disintegration theory, eskers were pushed up where movement of the drift occurred in opposite directions. Striations on bedrock might provide direct evidence that such movement has occurred in the vicinity of eskers. The direction of these striations would indicate that direction of movements of the drift during disintegration.

In the vicinity of eskers the drift is often quite thick, but in Finland, it has been scraped off in some areas and the direction of the striations near the eskers was observed. It was found that these marks were almost at right angles to the line of the esker.²⁵

This is direct evidence that movement normal to an esker has occurred in the drift nearby. The direction of the striations suggests that bodies of drift on either side of the esker pushed against one another, resulting in the esker being pushed up along the zone of intersection.

Glacial Hypothesis Inadequate

Many well known features of kames and eskers seem to fit the disintegration explanation of the drift, rather than the idea of glacial rivers having caused them.

Eskers are sinuous ridges which trend up and down slopes across the countryside. The up-and-down trend would be expected from a disintegration origin, but is difficult to explain in terms of glacial deposition.

The size of eskers does not decrease towards the supposed source, as would be expected if they were caused by rivers. If the river were very far above the base of the ice-sheet, it is difficult to see how the eroded chunks of bedrock could have become part of the esker. What would cause these rocks to rise through the ice?

It seems that rivers flowing within crevasses in an Ice Age glacier would freeze in winter, and would be unlikely to reform at the same place year after year and continue to build eskers.

The pattern of cross stratification within eskers is continuous with the drift of the vicinity, and no boundary exists below eskers or kames indicating they have been let down on previously deposited drift.

The direction of inclination of the cross-strata within eskers does not conform with the inferred direction of the glacial stream, or with the axis of eskers. Investigators studying the pattern of cross stratification within an esker in Scotland concluded the river that formed it flowed sideways, across the axis of the esker!²⁶

Tributary eskers occur which are just as prominent as the main esker. Eskers may end abruptly, and begin again further on in the same course. Some eskers, called "beaded eskers," consist of a series of isolated mounds. All this is quite unlike glacial river deposits.

In the glacial hypothesis of kames and eskers, there is no obvious relationship between the size of an esker and the thickness of the drift in the vicinity. Eskers ought to occur resting on bedrock, in fact.

However, there seems to be a very definite relationship between the drift thickness and the size of eskers and kames. In the region of Kitchener, Ontario there are several prominent kames, and the drift reaches 400 feet in thickness. In the theory of disintegration, eskers and kames would not occur where no drift layer was present.

When the concept of glacial rivers depositing kames and eskers is considered, two fundamental contradictions emerge. First, evidence that the ice overrode and eroded bedrock contradicts evidence that the ice overrode the surface of the drift. Second, drumlins in the vicinity of eskers are explained by movement of the ice, and the presence of eskers crossing the line of flow proves ice-motion was impossible. If the ice moved, why were these eskers not obliterated?

Conclusions

The idea of rocks disintegrating due to rapid release of pressure provides a new way of looking at the drift and associated landforms. In harmony with this concept, a mechanism exists for the creation of kames and eskers during uplift of the continents from the depths of the Deluge. Kames and eskers were formed due to effects of expansion of the drift, during disintegration.

Thus the drift phenomena can be considered as an effect of a world wide Flood having much more general geologic effects. As George McCready Price suggested, "the Drift *is not a prime event in itself*; it becomes only a *minor* event in the much larger problem."²⁷

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DID SEX EVOLVE?

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These remarks have come out of discussion of how hard it would be for sex to arise in plants and animals without definite planning and purpose before their creation.

In roughly one half of the individuals of a species which has different sexes there are organs which produce eggs; in the other half, sperm-producing organs. In many plants and a few animals however, these organs are found in the same individual.

Neither of these arrangements seems "higher" than the other; but each functions well in a specific environment. And it is very hard to see how the one arrangement, supposing it to have existed first, could have evolved into the other.

Creationists have formed their conclusions from observation of structure and function of plants and animals, along with definite statements in the Bible; e.g. "He who made them in the beginning made them male and female."¹

Evolutionists, on the other hand, look to an allembracing concept, "natural selection," to describe a beginning for sexual dimorphism. Yet creationists have often pointed out that natural selection explains only the elimination of unfit individuals and is powerless to make any living thing or species more fit for living.

The origin of sexual structures is one of the hardest for evolutionists to establish; they have no explanation. They simply fall back upon "armchair speculations" that all life started by chance and somehow became complex by an unexplained tendency for genes to change in all directions during reproduction.

Actual changes come from variations in the environment (water, temperature, light) or from some genes being kept latent while others are expressed. One can see that neither of these types of change is permanent, but rather is alternate. The less frequent type, mutation, will be discussed below.

So far some type of sexual reproduction has been found in most creatures, even bacteria and yeast, except the amoeba. Bacteria and yeasts have a very simple type of sexual reproduction which occurs infrequently. Commonly they get along remarkably well with simple cell division, or mitosis.

A yeast cell is a chemical laboratory producing alcohol and is invaluable in bread making; a bacterium changes sticks and straw to soil; and a food vacuole in an amoeba digests meat as effectively as the stomach of a dog. In their environment these creatures get along without sex. To establish a course for the evolution of sex one would have to find a very crude, inane being to begin with, and then trace the course up to man. This has not been done. A gradient has not been established.

If evolutionists are to rest secure in their supposition that sex arose by natural selection they must show that sexual structures can arise and develop gradually and that these structures help in the struggle for existence while they develop.

Perfection from Imperfection?

Consider the chromosomes of the fruit fly, *Drosophila*. A female fly has a pair of straight chromosomes which are called X chromosomes; and a male has an X chromosome, along with another called Y which has a hook at one end. If these chromosomes arose gradually they would produce flies with all sorts of organs and lack of organs while in an imperfect condition, while not matching properly.

Another example of the need for perfection to avoid retrogression is a gene, the most important part of a chromosome. The gene, in fact, is a code, much like a word or telegram, in that the genetic message depends upon the order of the units which compose it. If the order of the units in a gene is incorrect the message is garbled, the result is a mutation in the plant or animal which is developing. This type of change more often than not is lethal,² and very few, if any, such changes are beneficial to the plant or animal.

People who believe that sex developed by natural selection have formed their belief contrary to the evidence. Such changes as would occur would leave the organism a prey to natural selection, which eliminates harmful structures.

It is well known that it would be hard for a leg or fin to develop gradually by evolution, because, until it was far enough along to be functional it would be a drag, a disadvantage in the struggle for existence. Much more is this true of the formation of the organs of reproduction and heredity.

It is time to be done with assumptions which are no more than armchair speculations, and to turn to true science and the Bible. Both of those sources of information support the conclusion that the organisms having sex were so formed in the beginning.

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INTERDEPENDENCE IN MACROMOLECULE SYNTHESIS: EVIDENCE FOR DESIGN

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Macromolecules in the cell such as DNA, RNA, and proteins are interdependent for mutual synthesis. Within the cell, proteins used for enzyme catalysis, structural components, energy generation, and digestion of food, are produced through an amazing manufacturing process, involving DNA as a template for the three types of RNA (mRNA, tRNA, and rRNA), which in turn act as different components in the synthesis and coding of each protein molecule. But, each step in this complicated synthesis is catalyzed by an enzyme, which, since it is a protein, would have had to be synthesized by the same process! In other words, the end products of this reaction aid in the synthesis of the starting components and catalyzes each reaction along the way, making up a complicated series of interrelationships. In order to explain life, then, the appearance of this entire machinery must be explained.

Macromolecule synthesis in the cell is a very efficient process, far exceeding the efficiency of laboratory synthesis. This difference is due to the enzymatic activity of proteins in the cell. A reaction that takes many minutes or hours with low yield in the absence of an enzyme occurs in a split second with high yield in the presence of an enzyme which acts as a catalyst.

Enzymes are proteins. They are made up of 20 different amino acids which polymerize to form a long chain. Each amino acid has a side chain which provides the secondary structure and function of the enzyme. These side chains cause the enzyme to fold up and assume a globular structure. Some of these side chains

- 1. are hydrophobic—grouping together away from water
- 2. are hydrophilic-attracted toward water
- 3. are ionic—charged groups forming ionic bonds with each other
- 4. form hydrogen bonds
- 5. form disulfide bridges
- 6. form van der Waals bonds.

These weak bonds shape the enzyme in such a way that it holds a substrate molecule in a particular conformation where it reacts expeditiously (Figure 1). Each one of the amino acid side chains plays a very important role. They may aid in determining the structure of the enzyme, or act as the active binding site for the substrate (which is the compound in the reaction).¹

The importance of each amino acid side chain is illustrated by the fact that mutations which change the structure of the enzyme by placing a different amino acid in the enzyme usually render it inactive, although it is true that sometimes one amino acid may replace another without apparent ill effect. This may in turn render an entire synthesis useless in an organism. This will result either in death of the organism, or the organism may have to rely upon an outside source for a nutrient that it once synthesized. Changing an amino acid in an enzyme will often change its shape, making it impossible for the substrate to bind to it and react.

Large Number of Possible Proteins

The number of possible proteins of a given length of n amino acids is 20° , since there are 20 different amino

acids possible for each link in the protein chain.² The number of variants for a protein containing 100 amino acids would be 20^{100} . James L. King, in a symposium on the biochemical origin of life stated:

There are more theoretical possible proteins of, say, 100 amino acids long than there are particles in the universe, and only an infinitesimal fraction have been tested.³

How, then, can one account for such a high ratio of active enzymes to inactive enzymes found in life?

Complication of Enzyme Biosynthesis

Another complication in the biosynthesis of enzymes is the fact that even if the amino acids are synthesized in the right order, the enzyme still may be inactive due to the improper folding of the side chains.

It is necessary to ensure proper folding of the enzyme during synthesis. Otherwise, the enzyme usually folds up in a denatured (inactive) state. The proper conditions for folding to take place are provided by the structure of the cell.

The problem of denaturation makes enzymes difficult to isolate and purify in the active form outside the cell. Therefore, gentle techniques are needed for their isolation.⁴ There may be hundreds of possible denatured conformations compared with one active state.

How can one account for so many active enzymes in nature when laboratory synthesis is difficult and painstaking? The authors of an organic chemistry textbook outline this procedure:

The problem of protein synthesis is simply stated but not so simply realized in practice. Amide links must be formed to specific amino acids in sequence. For the amino acid being added to the chain, the group (amino or carboxyl) which is *not* involved in the amide formation must be protected first. Following amide formation the protecting group must be removed so as then to be reactive for addition of the next protected amino acid unit. Furthermore, the carboxyl must be converted to a more reactive acyl form in order to react with the amino of the joining amino acid. Hence the addition of just one amino acid to a growing chain involves several steps.⁵ (See Figure 2).

Laboratory syntheses outside the cell involve several complications. For instance, racemization of the amino acids occurs during synthesis, leading to mixtures of

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Figure 1. Enzyme-substrate interactions. The letters indicate various stages as follows: A. enzyme; B. substrate; C. enzyme-substrate complex; D. enzyme; E. end products of reaction.

proteins containing both D and L amino acids. In order to bring about a fair degree of purity to the polypeptide being synthesized, stepwise purification must be maintained. This process in long and difficult, and gives low yields at the end of so many steps.

An alternate procedure, solid phase peptide synthesis (Figure 3), speeds up the process, but sacrifices purity.⁶ The important question to be considered is this: how could an unknown *random* process "evolve" a "soup" of enzymatically active proteins resulting in life when a





Figure 2. Laboratory synthesis of a polypeptide.



Figure 3. Solid-phase peptide synthesis.

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highly controlled *laboratory* synthesis of these same proteins is difficult, produces low yields, and takes many days?

Left-Handed Amino Acid Dilemma

In his book, *Evolution: Possible or Impossible*, James F. Coppedge pointed out problems associated with the fact that proteins utilize only left-handed amino acids.

Usually when an amino acid is synthesized in experiments such as Stanley Miller's synthesis producing amino acids from a mixture of ammonia, methane, hydrogen and water by the treatment with an electric spark, a roughly equal amount of D and L isomers are produced. Since the D and L isomers react in the same way, and are the same in all respects chemically and physically except for the physical properties associated with assymetry, it is inconceivable that a random event could account for the formation of a protein with all L isomers.

Coppedge calculated that for an average protein molecule that contained 445 amino acids (of which 35 would be glycine, which is neither D nor L, leaving 410) the probability of random formation with all L isomers would be 1 chance out of 10^{123} (2⁴¹⁰).

In order to generate an idea of the magnitude of this figure, one could imagine one million protein chains forming per second for one quadrillion years. In that time, only 3.15×10^{28} protein chains would be formed. It is interesting to note physicists use a certain criterion: if the calculated probability for an event is less than 1 in 10^{40} , the results are usually considered out of the realm of possibility.

Coppedge also calculated the probability for formation of a set of 238 proteins, the minimal number which would sustain life. The odds against this event occurring during the history of the earth would be 1 in 10^{29345} , completely out of the realm of comprehension.⁸

Induction and Repression

One interesting feature of enzymes is that many times their activity is controlled by the concentration of the end-product of the synthesis they catalyze.

Several different types of control exist: (1) repression —where the end product inactivates the enzyme; (2) induction—where the end product activates the enzyme; and (3) co-repression—where the end product activates a repressor which deactivates the enzyme.

In end product **repression**, the enzyme may catalyze the first of many steps in a reaction. As the synthesis nears completion, the concentration of the end product increases. The end product, acting as a repressor, binds to the enzyme at a specific site, forcing the enzyme into a different conformation. As a result, the enzyme cannot catalyze the reaction.

Co-repression acts in a similar fashion, except in this case, the end product binds to the repressor, activating it, which in turn deactivates the enzyme. Also, enzymes can be activated, or **induced**, by the end product of another reaction.⁹ (See Figure 4).

Such properties are important in the regulation of all of the syntheses that take place in the cell. How could these properties have arisen? It is a little like the old



Figure 4. Enzymes can be activated, or induced, by the end product of another reaction. Letters indicate the various stages, as follows: A. enzyme, the substrate binds to the enzyme and reacts; B. products of reaction; C. subsequent reactions; D. end product repressor; E. repressor binds to enzyme, forcing it into a different conformation; F. substrate can no longer bind to enzyme.



e = energy

Figure 5. Synthesis of enzymes. Here the various stages, etc., are indicated by numbers, as follows: 1. DNA Synthesis. DNA polymerase; 2. rRNA Synthesis. RNA polynerase; 3. tRNA Synthesis. RNA polynerase; 4. mRNA Synthesis. RNA polymerase; 5. Transfer of amino acids to growing polypeptide chain. Amino acyl synthetase; 6. Breakdown of food; 7. Production of energy.

"chicken and egg" dilemma; which came first? Since the enzymes, substrates, repressors (or co-repressors or inducers) and intermediate reactions are so interdependent, if the origin of one is explained, then the origin of the others must also be explained, since each have binding sites that match the other.

End product repression and control is absolutely necessary for the processes in the cell, since it regulates the amount of each product synthesized. Combined with the hundreds of other reactions in the cell, it makes up an "ecology" within the cell, where nothing is wasted, but everything is synthesized in exact amounts where it can be utilized by the cell. These interrelationships provide evidence that the cell was *created* as an entire entity, and did not "evolve" from separate molecules.

Relationships in Enzyme Synthesis

One of the most complex and interesting relationships occurs in the synthesis of these enzymes. Each step of the synthesis of enzymes is **catalyzed by enzymes**. The DNA molecule is the template for the synthesis of proteins. However, DNA is synthesized in the presence of DNA polymerase, an enzyme which is in turn coded by DNA! This highly interrelated synthesis¹⁰ is outlined in Figure 5, and may be summarized: 1. First of all, the DNA template is polymerized from mononucleotides in the presence of DNA polymerase and single stranded DNA.

2. Next, in the presence of RNA polymerase, double stranded DNA unwinds, initiating the transcription of the three types of RNA; mRNA, tRNA, and rRNA. Below is a description of these three types and their function:

a. mRNA. This is known as messenger RNA, carrying the genetic code for the protein being synthesized.

b. tRNA. This is known as transfer RNA. tRNA transfers the amino acids for the protein being synthesized.

c. rRNA. This is known as ribosomal RNA, and makes up a structural component of the ribosome, complexing with the ribosomal protein, providing a framework for protein synthesis.

3. Each RNA molecule has a specific function in the synthesis of proteins, with a three dimensional structure that has specific binding sites on which they interreact. Messenger RNA transfers the code for the protein from the DNA molecule to the ribosome, where protein synthesis takes place.

4. Each mRNA will have a string of ribosomes which interpret the genetic code attached to it, re-

sulting in many protein molecules per mRNA. The ribosome, made up of ribosomal protein and rRNA, aid the synthesis by providing a framework upon which the mRNA and tRNA are able to bind together. Three nucleotides on the mRNA correspond with three nucleotides on the tRNA; this in turn transfers another amino acid to the growing polypeptide chain.

Altogether, there are quite a number of enzymes important in enzyme production. DNA polymerase initiates the polymerization of DNA, RNA polymerase initiates the formation of the three types of RNA, amino acyl synthetase aids in the transfer of the amino acid to the polypeptide chain, ribosomal protein make up the structural components in ribosomes. Without these important enzymes, enzyme synthesis cannot occur. Yet, they are synthesized by the same processes they catalyze!¹¹

Another Important Interrelationship

Functions of proteins in energy generation and the breakdown of food are also closely related to the synthesis of enzymes since the reaction cannot occur without a source of energy or building blocks from which the protein will be synthesized. Without enzymes to catalyze the production of energy in the cell, biosynthesis will not continue. Each step involved in the synthesis of macromolecules from monomers requires a great deal of energy, which is provided by activated nucleosides such as ATP. This energy is derived from assimilated food particles, broken down for use by the cell with the aid of enzymes.

No Driving Force For Natural Selection

Many evolutionists attempt to explain the interrelationships that exist in the cell by saying that "natural selection" is responsible for them. The problem with this is the fact that at the molecular level, the proteins and polynucleotides which had not developed interrelationships would not have the physical machinery available for "natural selection" because there would be no mechanism to convert energy into useful work.

Natural selection, as it is observed in living organisms, is a process that involves the weeding out of organisms that already exist in the environment. It does not explain the origin of these organisms or their genotypes.

Mutations have been proposed as the "driving force for natural selection", but at the molecular level, the situation is life or non-life. Mutations cannot explain the origin of the genetic code or the machinery surrounding protein synthesis, since they are a result of the operation of this machinery. To date, no other mechanism has been proposed.

Minimal Protein Content in Cell

Watson, when discussing Rickettsia, mentioned a lower size limit for dividing cells which would contain between 750 and 1000 genes.¹² He expressed disbelief that a cell could be smaller than that since it would imply that there would be at the fewest 100 different proteins to maintain the living state. Coppedge quotes a different estimate at 238 proteins.¹³

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Therefore, taking the lower estimate, if one is to believe in "evolution", then one would need to imagine 100 different proteins being formed by random processes, all left-handed, in the right weak bond conformations, specific for one another, coming together and taking their place in protein synthesis, energy production and the breakdown of food, plus the synthesis of cellular components. One would also need to envision the production and synthesis of DNA and RNA, lipids, polysaccharides (which, by the way, are all of the D isomer), and many other cellular components of which would have to be in the active state to carry out their specific function in the cell.

Let us consider the interrelationships between DNA, enzymes, substrates, repressors, and co-repressors. During the course of "evolution", if DNA "arose" first, and coded for the enzyme, it would have to contain the genetic information for the binding sites on the enzyme specific for the substrate and repressor, with the repressor having binding sites specific for the corepressor. If the enzyme "arose" first, one would need to explain how the DNA "developed" a genetic code which would reproduce this enzyme, using the enzyme as a template. Watson ruled out the possibility of enzymes acting as a template, however, since the side chains differ in their composition in several cases only by a methyl group.¹⁴ Here again, the better explanation would be to say that it was *created* by God with that design in mind.

Origin of Cenetic Code

"Evolution" of the genetic code is a problem that staggers that imagination. Could an organism survive under the condition of a half-developed genetic code that codes for a wrong amino acid as often as a correct one? How many inactive, useless enzymes would be developed, using up valuable energy in the cell? Dr. James L. King, an evolutionist, stated in a symposium on the origin of life:

It is hard to imagine how an organism might survive with an ambiguous genetic code, but there are many other aspects of early evolution that are also hard to imagine.¹⁵

Often, scientists will make the statement that an "enormous selective pressure" must have been placed upon the cell for the formation of a genetic code. Such statements are meaningless without an explanation of what would provide that "selective pressure". Would an organism with an ambiguous genetic code survive at all?

The genetic information that the DNA molecule must contain is astounding. How can one explain that a finger will grow out to a certain length and then stop? What determines the shape of a nose or the morphology of an eye? Furthermore, what are the associated regulatory processes that determine the shape and size of all of the parts of an organism?

It is significant to note that the DNA content of an organism does not necessarily determine its "complexity". Many fish and amphibians contain 25 times more DNA than any mammalian species. Many "closely related" species have been found that vary in DNA content by a factor of five to ten.¹⁶ How could such species be "related"?

Interrelationship Problem Ignored

It is significant that most books on the subject of "biological evolution" do not deal with the problem of interrelationships adequately, usually ignoring the question. An example is found in Brock, dealing with the origin of life:

From an organic soup of small molecules and macromolecules to a primitive living organism is a giant step. There are two basic features that primitive organisms must have: (1) metabolism, that is, the ability to accumulate, convert, and transform nutrients and energy, and (2) a hereditary mechanism, that is, the ability to replicate and produce offspring. Both of these features require the development of a cellular structure. Such structures probably arose through the spontaneous coming together of lipid and protein molecules to form membranous structures, within which were trapped polynucleotides, polypeptides, and other substances. This step may have occurred countless times to no effect; but just once the proper set of constituents could have become associated, and a primitive organism arose. The original organism would have found itself surrounded by a rich supply of organic materials usable as nutrients for energy, metabolism, and growth. From here on, evolution was relatively simple and perhaps inevitable*, resulting in our present biological diversity, including man.¹⁷

Most textbooks do not deal with the problem any more than that. But, in order to explain the existence of life, **interrelationships** must be explained. The abundance of interrelationships in living things indicate that they were created simultaneously. As there is ecology between the organisms, so there is an "ecology" between the cells within an organism, interdependent upon each other, and an "ecology" between the molecules within each cell. Each has a purpose and place.

In the single celled organism, *Escherichia coli*, the chromosome codes for 2000 to 4000 different polypeptide chains. It is estimated that for the cell to grow on glucose as the sole carbon source, between 600 and 800 enzymes are utilized to conduct the syntheses needed for growth.¹⁸ Imagine the number of random events needed to explain these syntheses and their components! Consider that each of these enzymes is interdependent *upon the others* to do a particular job.

Interrelationship of Repair Processes

Another amazing interrelationship involves repair processes that occur in the cell. Several types have been identified, involving repair of genes damaged by ultraviolet radiation. The best understood case is the thymine-thymine dimer, which occurs when two adjacent thymines are irradiated with ultraviolet light. This event normally kills the cell if left unrepaired, since the fused thymines cannot act as templates for new strains. Fortunately, the cell has a series of enzymes that will digest away these nucleotides and those around it, replacing them with new, correct, nucleotides.¹⁹ But, amazingly, if this repair synthesis is somehow blocked, another synthetic pathway exists that takes over and repairs the problem!²⁰ Truly, this cannot be a product of mere chance, but it is a series of "checks and balacces" instilled in life by the Creator to insure survival.

Here, mutations should be mentioned, since many mutations occur due to mistakes made during the repair of damaged genes, or mistakes made while reading the DNA templates. Such mutations are either recessive, nonfunctional, lethal, repaired, or weeded out by other means.

If nucleotides are switched in the genes, it will lead to nonfunctioning or partially functioning enzymes.²¹ It is interesting to note that evolutionists say that mutations provide the "driving force for evolution"; yet much fear is generated by the thought of mutations caused by irradiation with ultraviolet light, or by atomic radiation. Could the process of mutation, which is actually a degenerative process consistent with the second law of thermodynamics, account for "evolution", which would have to be a "continually improving" process?

What is the origin of these marvelous repair processes? Certainly not mutations since the repair processes function to eliminate or weed out mutations. Consider building a machine in which, if anything goes wrong, internal processes would be available for immediate repair. This is the situation that exists in all forms of life, even in the "least complex" cell.

Like a computer that prints out a message when it short circuits, there are two biosynthetic pathways in the cell which recognize and repair the thymine dimer problem in the DNA molecule. Four steps occur in the repair: (a) recognition of the damaged region by a specific endonuclease, (b) digestion of the nucleotides adjacent to it by an exonuclease, (c) synthesis of a new strand of nucleotides pairing with those on the intact strand, and (d) joining of the two ends by a polynucleotide ligase.²²

What initiates each of these steps? What starts the synthesis of the enzymes needed for the repair of this damaged region? How much genetic information is required? And, in the unlikely event that this pathway is blocked and cannot function, another pathway exists which takes over and performs the repair!

Antibodies

Perhaps the most complex and least understood interrelationship occurs in the formation of antibodies. The introduction of a foreign particle into an organism triggers the formation of antibodies specific for this particle.

All antibodies are proteins. They consist of four protein chains, two heavy chains and two light chains (see Figure 6). There are two active sites on the antibody, each of which may bind to the foreign particle, rendering it inactive, and transporting it out of the cell. Each of these active sites is made up of variable sequences of amino acids which recognize the foreign particle and bind to it.

^{*}Faith is the substance of things hoped for, the evidence for things not seen (Hebrews 11:1). This material from Brock contains a perfect example of the exercise of *faith*.

CHO CHO F

Figure 6. The construction of an antibody. H indicates a heavy chain; L a light chain. Shaded parts, as V, indicate variable regions; light parts, as F, fixed regions.

This poses the problem of the amount of genetic information needed to produce antibodies. Watson described this problem in detail:

The existence of distinct amino acid sequences for each specific antibody immediately raises the question whether there is a distinct gene for each antibody. Since a given antibody-producing animal can produce a very large number of antibodies, it is possible that a very large number of genes might code for the amino acid sequences of antibodies. For many years this possibility has seemed repugnant to many immunologists, aware of the immense number of antigenic determinants. Now, however, the dilemma can no longer be avoided. Since the amino acid sequences are different, there must exist corresponding differences in their mRNA templates, and thus in the relevant DNA regions.

We are also faced with the problem that, if different genes exist, there must be a control mechanism by which the presence of an antigen tells the gene controlling a corresponding antibody to function. In some way, the presence of an antigen must cause the selective synthesis of unique amino acid sequences (the selective theory of antibody formation).²³

From the introduction of the foreign particle into the organism to the formation of the antibody, several events must take place—either the construction of genetic information in a DNA molecule which would transcribe the specific amino acid sequence in the antibody, or the triggering of an already-existing DNA molecule specific for the antibody which neutralizes the foreign particle.

Contemplate the origin of this amazing process! Consider the tightly controlled interrelationships involved, and their origin. How can the "recognition" of foreign particles by a cell be explained, when previous to entry into the cell by the antigen, it has no "knowledge" of what it "looks like"?

Protein Repair?

Coppedge mentioned an experiment where proteinlike chains containing both D and L amino acids were

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put into a living organism. The organism immediately took them apart, excising the D amino acids, and in some cases rebuilt the amino acids in the L form!²⁴ Where would an organism get the "ability" to recognize these foreign molecules, take them apart, and repair them in this manner?

Interrelationships Demand Creation

If one chooses to rule out the possibility that God created life, he is faced with some rather discouraging probability figures. Coppedge's calculations of 1 in 10^{123} for the formation of a protein of 445 amino acids in length, and 1 in 10^{29345} for the formation of an aggregate of proteins minimal for the existence of life are computed on the basis of the left-handed amino acid problem alone.²⁴

Consider that each protein must have the correct amino acid sequence; the correct weak bond secondary, tertiary and quaternary structures; and be interrelated with other enzymes, polynucleotides, substrates, repressors, co-repressors and inducers. Correct genetic information for the formation of each of these components and the synthesis machinery for their production must exist. Energy generation and metabolism must also be available.

Interrelationships provide evidence that life was created suddenly. Most macromolecules, when left outside a living system unprotected, quickly denature or break down into individual amino acids. The so-called primitive environmental conditions which have been postulated to produce these macromolecules would also aid in their eventual destruction. Long periods of time, therefore, becomes an enemy to the "evolution" of proteins.

Life does not occur without the existence of interrelationships between these macromolecules, ruling out a random gathering of proteins and polynucleotides over a long period of time. An "ecology" exists between the molecules within the cell, as exists between cells within an organism, and between organisms in nature. All are interdependent upon one another. It follows that *life began suddenly*, created by God, with these interrelationships built in.

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THE HEART OF CREATION

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Introduction

Students of comparative chordate anatomy often are given the impression by professors, and authors of certain textbooks, that a study of the vertebrate heart will lead to a deepened understanding of the evolutionary "perfection" of the blood pumping organ from a simple two-chambered to an elegantly efficient fourchambered structure.

Fishes characteristically have a single atrium and single ventricle; amphibians have two atriums and one ventricle; the reptilian model has two atriums and partially divided ventricle; whereas birds and mammals all possess two completely separate atriums and ventricles.

However, even though vertebrates have been classified in an order which some have felt implies evolutionary progression, it usually is no simple task even with just a single organ like the heart to demonstrate how a "higher" (such as avian or mammalian) organ may have been modified from a "lower" type (such as amphibian or reptilian); and because of the nature of these studies it **never** is possible to demonstrate genetic connection between the forms.

Birds and mammals are homeothermic (warmblooded) and they have separate pulmonary and systemic blood circulations with generally no mixing of the two blood streams, whereas amphibians and reptiles with their single-chambered or only partially divided ventricle often in past decades have been thought of as possessing inefficient systems because their oxygenated pulmonary blood and deoxygenated systemic blood would mix in the ventricle. Yet these poikilothermic (cold-blooded) organisms seemed to be surviving very well, often in the presence of many avian and mammalian predators.¹

"Perfection" of Heart Abandoned

The idea that the birds and mammals have *perfected* cardiac structures must be abandoned, as E. Bruce Holmes recently pointed out.² In amphibians the ventricles contain muscular columns (trabeculas) which give the ventricular cavity a sponge-like surface, this anatomical feature coupled with laminar blood flow tending to keep streams of oxygenated and deoxygenated blood separate. Additionally, as is widely believed now, some mixing of pulmonary and systemic blood in the ventricle may be an advantage for amphibians with

their well-developed cutaneous circulation which allows for considerable breathing through the skin.³

Interestingly also, as Romer and others have noted, modern amphibians have a simpler cardiac structure than do lungfishes which have partial septums between their two atrial and two ventricular chambers.⁴ This problem has led anatomists to state that the amphibian heart is either degenerate or just primitive.

I see no good reason at present to believe other than that the amphibian heart was produced independently of the lungfishes or their ancestors. In consideration of avian and mammalian hearts which are alike in being four-chambered, and according to phylogenetic speculations convergently came from reptilian ancestry, perhaps many unnecessary problems likewise will be avoided if these forms are considered to be independent of each other and of a reptilian progenitor.

Reptilian Heart "Evolution" Questioned

Is the partially divided reptilian ventricle an intermediate stage between the right and left chambered ventricular condition of birds and mammals, as some evolutionists suggest? Holmes has pointed out that lizards, snakes, sphenodon and turtles have the same type of heart, this being unique among vertebrates and not readily comparable with birds and mammals.

The reptilian ventricular lumen is subdivided by two incomplete septums into three chambers. The major septum is horizontal and almost always well-developed, whereas the second septum which is vertical, may in some forms be undeveloped and thus indistinguishable from other muscular columns.

The reptilian feature which is unique among vertebrates is the horizontal septum. Yet within the reptilian category also are the crocodilians which have a vertical septum more like other vertebrates, but on the basis of other structural considerations most phylogenists do not consider crocodilians close to what might be expected for an amphibian to bird-mammal link. In a review paper on current understanding of reptilian circulation F. N. White expressed concern over many spurious phylogenetic interpretations:

Reptiles, in their cardiac structure, simply do not represent some imperfect stage in an evolutionary process eventually culminating in the mammalian condition. Rather, the contemporary reptiles possess some unique solutions to circulatory needs in which the cardiac distributional patterns show a range of options unavailable to birds and mammals.

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As we study the various distributional patterns, we will probably learn that they represent special adaptations rather than an expression of transitional evolutionary stages.⁵

The basic developmental design for all vertebrate hearts involves a longitudinal tube which forms an Sshaped structure. Adult fish have this structure. For other vertebrates there is a folding of the tube and further development aided by hemodynamic conditions so that finally the organ characteristic of the species is formed.

Conclusion

In studies of the vertebrate heart it would appear beneficial if students of comparative anatomy could be relieved of the tension to explain details of cardiac anatomy and physiology in phylogenetic terms and be encouraged to understand the various features with primary attention on needs of particular organisms in their environments.

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AN ANALYSIS OF THE POST-FLOOD POPULATION GROWTH

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The world population growth after the Noachian Flood is analyzed. Several independent mathematical methods indicate that a population of many millions could have resulted after 200 years starting from Noah and his family.

Problem and Procedure

The population growth of the world population immediately after the Noachian Flood is examined both analytically and numerically. The author will ascertain whether or not geneological gaps are needed in Genesis 10 and 11 in order to account for a sufficiently large population capable of accomplishing the Tower of Babel, the Pyramids, and other Biblical and secular events, which must fall in the first few hundred years after the Flood, if one holds to a chronology after the manner of Ussher, Issac Newton, Courville, et al.

Computations show that, with respect to population growth, geneological gaps are not needed and that under reasonable assumptions, derived primarily from Genesis 10 and 11, a world population of many millions could have arisen within 200 years after the Flood. A review and some results of the following analytical approaches are presented:

(1) The problem has been formulted as an inhomogeneous birth-death stochastic process proceeding in the usual manner from the Chapman-Kolmogorov equation. A very large population growth after the Flood can be obtained but present day population statistics could not be superimposed on the model thus suggesting the extraordinary conditions in the immediate post-Flood era.

(2) Kendall's solution of the inhomogeneous birthdeath process is discussed and a simple post-diluvian population formula is presented.

(3) Karlin's deterministic model is presented and a solution method suggested.

(4) The present state of the art of the formulation of such population problems is discussed.

In addition to analytical investigations, a direct numerical simulation for Karlin's model has been performed. These simulations and the other calculations were performed on The Cleveland State University IBM 370/158 system. This simulation conclusively shows the possibility of a large population growth as is verified and strengthened by analytical investigations.

Introduction

In recent years there has been a tendency, on the part of many creation scientists, to assume tacitly the existence of genealogical gaps in the geneologies of Genesis 5, 10 and 11 and elsewhere; for example see references 1-5. In fact, it is because of these alleged gaps that an age from the Creation of 10,000 years is being suggested more and more. This addition of nearly 4,000 years over the traditional chronologies of Ussher, I. Newton, Marsham, et al.,^{6,7} has very possibly gained acceptance through the popular prolific writings of H. Morris and J. Whitcomb, who at least grant the possibility of gaps.

The writer holds that no gaps can exist; and that a complete and exact chronology is important to the Christian in order that he be watchful (e.g. Prov 8:34; Mt 24:42; Luke 12:37, 38; 21:36, Eph 6:18, 1 Pet 4:7; Rev 3:2, 3, 16:15) for signs and seasons (e.g. Mt 24:3, 30, Luke 21:11; Act 1:7; 1 Th 5:1; Heb 2:4; Rev 15:1), just as it was important to the wise men coming from the east (Mt 2:1, 2). By an exact chronology I mean a chronology to-the-day as providentially perfectly preserved in the King James Version (as all modern

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translations have taken liberty with numerical information thus obscuring the Biblical chronology).

It is not my purpose, here, to deal with the general subject of chronology and the attendant problem of Scriptural preservation, but instead to discuss only the problem of population growth immediately after the Flood. In this respect I concur with the sense of the recent post-Flood chronologies of Ozanne⁸ and Courville.⁹⁻¹²

It is often implicitly alleged or stated that the lack of sufficient population immediately after the Flood necessitates the assumption of additional (missing) generations in Genesis 10 and 11. This assumption, one is told, is required due to the short time scale provided by the Ussher chronology versus the large population required by Biblical and secular events, such as the building of the Tower of Babel and the Pyramids. For example, it is frequently stated, that within Ussher's 200 years from the Flood it would be impossible to build the Tower with the small population available.

The Ussher chronology is not being defended specifically; however, the term will be used generically to represent chronologies incorporating no gaps of time, genealogical or otherwise (I hasten to add that Ussher's much maligned magnificent piece of research is indeed worthy of defense).

The principle being argued here is gaps versus no gaps; for if there must be gaps in Genesis 10 then why not in Genesis 5 or in the lineage of Moses (Ex 6), or David (Ruth 4), or any number of places bearing on the chronological reckoning of The Biblical record. This paper attempts to show that in Genesis 10, this most sensitive and argued place, one cannot argue for gaps based on insufficient population.

In the sections that follow, increasingly more general models for the post-Flood population problem will be presented. This problem is an age-dependent branching process having a variable longevity and reproductive period. This general problem is seldom treated in the literature, except qualitatively; and approximations seems to give only marginal insight and quantiative information. Several methods are included in order to provide a survey of mathematical tools applicable to Biblical population analysis and in order to provide a motivation for more general models.

(1) The H. M. Morris Solution

In reference 3 Morris provided the following hueristic solution based on the geometric series, from which he suggests that only 1000 people would be available to build the Tower of Babel if one accepts the Ussher chronology. Hence he argued for the possibility of gaps amounting to a few hundred years in Genesis 10 and 11.

Following Morris, let n_0 be the initial population and c be the number of offspring per family. Assume that the total population continually remains equally male and female, and that no deaths occur; then it follows that

$$S_n = n_0 + n_0 c + n_0 c^2 + \dots = n_0 (c^{n+1} - 1)(c-1)^{-1}$$
(1)

where S_n is the total population after n generations.

Morris corrects this sum by assuming all individuals have a life span of x generations,

$$S_{n,x} = S_n - S_{n-x} = n_0 c^{n-x+1} (c^x - 1) (c - 1)^{-1}$$
 (2)

On the basis of the Ussher chronology Morris seems to suggest $n_0 = 8$, n = 3, c = 5, and x = 5 yielding $S_{n,x} = 1000$. This model rather well described the present day world population growth and provides a devasting refutation of evolution theory;³ but it is less successful as a means to describe even moderately well the complexitities attendant with starting from a small number of individuals, 8, whose longevity is about 650 years as compared with 70 of their distant progeny.

The complication of a variable longevity and the associated variable reproductive period is inconsistent with the simple model provided by a geometric series. One cannot properly speak in terms of a constant generation as incorporated by n, and similarly for the longevity measure x and growth measure, c.¹⁵

These criticisms are quite obvious; still the simple geometric model has served well in stimulating further research in population dynamics.¹³⁻¹⁵ Lastly, it should be noted that although this model is usually used to demonstrate a very small population at 200 years after the Flood, it likewise can be used to demonstrate a large population. For example if one neglects deaths, which seems to be permissible in light of the great life spans of man from Shem to Eber, then as an approximation $S_n/n_0 = c^n$. If n = 5 and c = 10, 15, 20, 25 then $S_n/n_0 = 10^5$, 7.6×10^5 , 3.2×10^6 , 9.8×10^6 respectively. It will be shown, subsequently, that more accurate versatile models also yield results in the millions or greater.

The Birth-Death Process

The Chapman-Kolmogorov equation is invoked in the usual manner^{10.20} in order to model the problem as an inhomogeneous birth-death process. Let the process be defined by the transition probabilities for a single death, no change, one birth and a double birth where the following form is assumed;

$$p_{2} = P[x \rightarrow x + 2, t\epsilon(t, t + \Delta t)] = c_{2}(t) x \Delta t$$

$$p_{1} = P[x \rightarrow x + 1, t\epsilon(t, t + \Delta t)] = c_{1}(t) x \Delta t$$

$$p_{0} = P[x \rightarrow x, t\epsilon(t, t + \Delta t)] = 1 - (c_{1} + c_{2} + c_{3}) x \Delta t$$

$$p_{-1} = P[x \rightarrow x - 1, t\epsilon(t, t + \Delta t)] = c_{3}(t) x \Delta t$$
(3)

where x is the population at time t. c_1 , c_2 and c_3 are functions of time only which, one hopes, can be selected so as to reflect the variable longevity of an individual. These probabilities have been assumed to be proportional to the current population. The Chapman-Kolmogorov equation for this process is

$$P(x, t + \Delta t) = \sum_{i=-1}^{2} p_i P(x - i, t)$$
 (4)

Combining and rearranging gives

$$P'(x, t) = \lim_{\Delta t \to 0} (P(x, t + \Delta t) - P(x, t))/\Delta t$$
(5)
= c₂(x - 2) P(x - 2, t) + c₁(x - 1) P(x - 1, t)
-(c₁ + c₂ + c₃)xP(x, t) + c₃(x + 1) P(x + 1, t)

where a prime will indicate differentiation with respect to time. This differential-difference equation requires the following boundary conditions;

$$P(x_0, 0) = 1 P(x, 0) = 0, x \neq x_0$$
(6)

where x_0 is the initial population at time t = 0. Let m(t)denote the mean of this process,

$$m(t) = \sum_{x=x_0}^{\infty} x P(x, t)$$
(7)

from which after some summation manipulation in combination with the expression for P'(x, t) gives,

$$m'(t) = \sum_{x = x_0}^{\infty} xP'(x, t)$$

$$= R(t) m(t)$$

$$m(t) = m(0) \exp(\int_{0}^{t} R(\tau) d\tau)$$
(8)

where

$$R(t) = 2c_2 - c_1 - c_3, \ m(0) = x_0$$
(9)

Consider the following selection for c_1 , c_2 and c_3 :

$$c_{1}(t) = a_{1}e^{-\beta_{1}t} + \delta_{1} \qquad (a_{1}, \beta_{1}, \delta_{1}) > 0$$

$$c_{2}(t) = a_{2}c_{1}(t) \qquad a_{2} > 0$$

$$c_{3}(t) = a_{3}(1 - e^{-\beta_{2}t}) + \delta_{2} \qquad (a_{3}, \beta_{2}, \delta_{2}) > 0 \qquad (10)$$

This selection is governed by its mathematical tractability, and its qualitative properties with regard to information in Genesis 10 and 11 and present day population statistics. Note that for large t the c_i approach positive constants, and the model becomes the simple-birth-death process¹⁷ which satisfies population growth in present times.

The exponential contribution is included in order to acknowledge the peculiar circumstances of exponentially decreasing longevity after the Flood. This is a purely hueristic assumption for it is not clear that an exponential transition probability intensity should be able to express an exponentially time decaying longevity. A fortiori, the birth-death model is itself quite arbitrary, lacking sufficient flexibility to straightforwardly represent this complicated population problem.

Combining the c_i with the expression for m(t) yields,

$$m(t) = m(o) \exp(V(t)t)$$
(11)

^t)) (12)

where

$$V(t) = A_0 + t^{-1}(B_1(1 - e^{-\beta_1 t}) + B_2(1 - e^{-\beta_2 t}))$$

and

$$A_{0} = \delta_{1}(2a_{2} + 1) - a_{3} - \delta_{2}$$

$$B_{1} = \beta_{1}^{-1} a_{1}(2a_{2} + 1)$$

$$B_{2} = \beta_{1}^{-1} a_{3}$$
(13)

The function, V(t) is the exponential growth parameter. For small t, the first two terms of the Taylor expansion for the exponential function gives, $V(t) = (A_0 + \beta_1 B_1 + \beta_2 B_1)$ $\beta_2 B_2 t$. For large t, $V(T) = A_0$. This seems qualitatively correct in that immediately after the Flood the growth parameter increases with time whereas for large times the parameter is constant.

Let it be required to solve for A_0 , B_1 and B_2 from three boundary conditions and given values for β_1 and β_2 . Let m(o) = 6 be the generation surviving the Flood from which the world was repopulated. Let the present time be $t_p = 4300$ years and the present population be $m(t_p) = 2 \times 10^9$. (doubling this figure would not change the conclusions much.) Current world popula-

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tion figures of the relative rate of growth indicate that $m'(t_p)/m(t_p) = .018.$

Lastly, 15 male offspring of Noah's sons, Shem, Ham and Japeth are listed in Genesis 10. If there were an equal number of female offspring (Gen. 11:11) and, if t_1 is the length of this very first generation then $m(t_1) \approx 30$. It would seem reasonable to assume this number to be much larger. From Gen 11:10 it seems plausible, for the moment, to assign $t_1 = 10$. Next define,

$$k_{1} = \ln(m(t_{p})/m(o)) k_{2} = m'(t_{p})/m(t_{p}) k_{3} = \ln(m(t_{1})/m(o))$$
(14)

which with the just mentioned figures give, $k_1 = 20$, $k_2 = 0.018$ and $k_3 = 1.61$. Also, temporarily assign $\beta_1 = 10^{-4}$ and $\beta_2 = 10^{-4}$. Hence a linear system in A_0 , B_1 and B_2 results:

^ ,

$$A_{0}t_{p} + B_{1}(1 - e^{-\beta_{1}t_{p}}) + B_{2}(1 - e^{-\beta_{2}t_{p}}) = k_{1}$$

$$A_{0} + B_{1}\beta_{1}e^{-\beta_{1}t_{p}} + B_{2}\beta_{2}e^{-\beta_{2}t_{p}} = k_{2}$$

$$A_{0}t_{1} + B_{1}(1 - e^{-\beta_{1}t_{1}}) + B_{2}(1 - e^{-\beta_{2}t_{1}}) = k_{3}$$
(15)

Due to the great size of t_p compared to t_1 , even double precision computation (16 significant digits) fails to solve this system, i.e. a prohibitively small determinant results. Hence in order to test this model m(t) vs. t has been computed for a wide selection of values for A_0, B_1 , B_2 , t_i , $m(t_1)$, β_1 and β_2 holding t_p , $m(t_p)$ and m(0) as assigned. A great many plausible combinations yielded values of m(200) on the order of 10⁶ to 10⁹. However, all these cases produced values of $m(t_p) \approx 10^{30}$ which are absurdly large compared to $m(t_p) = 2 \times 10^9$.

Hence, it seems that the birth-death model employing simple, but plausible, transition probabilities is capable of modeling either the immediate post-Flood population or modern population, but not both simultaneously. It especially is to be noted that very large early populations occur. No further attempt will be made to find expressions for the c_i that would fit the data embodied in the values of the k_i . One obvious embellishment would be to include a more prolific model for double births and to permit higher order multiple births. This will be discussed later.

(2) Kendall Inhomogeneous Birth-Death Process

Before proceeding to more complicated models it will be instructive to note the utility of Kendall's solution of the inhomogeneous birth-death process^{16,17} in that it may provide useful population formulae for the post Flood period as well as other periods of Biblical history such as the exceptional growth of the Israelites in Goshen (Ex 1).

For the general problem given by

$$P[x \rightarrow x + 1, t\epsilon(t, t + \Delta t)] = \lambda(t) x \Delta t$$

$$P[x \rightarrow x - 1, t\epsilon(t, t + \Delta t)] = \mu(t) x \Delta t$$
(16)

Kendall^{18,19} has solved for P(x, t). This is here mentioned because it is about the only stochastic process of sufficient generality to be potentially applicable to Biblical research for which P(x, t) can be explicitly exhibited.

From the previous section it follows immediately that

$$m(t) = m(o) \exp(\int_{0}^{t} (\mu(\tau) - \mu(\tau)) d\tau)$$
 (17)

For example if

$$\lambda(t) = a_0 + a_1(t + a_2)^{-1}$$

$$u(t) = \beta_0 + \beta_1(t + \beta_2)^{-1}$$
(18)

for constants a_1 and β_1 then

 $m(t)/m(o) = (a_2 + t/a_2)^{a_1} (\beta_2 + t/\beta_2)^{\beta_1} e^{(a_0 - \beta_0)t}$ (19)

These choices for $\lambda(t)$ and $\mu(t)$ permit rough approximations over $t \in (0, \infty)$ for the exponentials of the last section²¹ while yielding a simpler result.

This process and the fact that it can be analytically solved should be of special interest to Bible Science researchers. Arley²² has used this process in presenting, probably, the most detailed mathematical study of cascade showers in cosmic ray theory. This is important in the anlaysis of C-14 dating.

Bailey¹⁷ (p. 115) has generalized Kendall's solution for P(x, t) to include the effects of immigration. Though this solution is quite complicated, it does provide a closed form solution which is susceptible to direct numerical evaluation or generating function methods. Detailed studies of the historical demography and population growth of the race of the messianic line cannot help but include the effects of immigration. For example, consider the Gibeonites (Josh 9) and the law of the stranger (Lev 19:34, Ex 22:21, Deut 31:12, Heb 13:2).

(3) Karlin Deterministic Model

In this section the rather general model of Karlin²³ (pg. 360) will be presented. Solution of the model by Monte Carlo simulation will be given in the next section. Simulation permits even more embellishments, complexities and generalities than do deterministic models. The important aspect of this deterministic model and of the subsequent simulation, is the inclusion of age-dependent branching and parental survival which is essentially a non-Markovian property, and hence may appear to be included into the Markovian birth-death process only by various contrivances.^{16, 17, 23}

Let $\rho(a, t)$ be the frequency function of individuals of exactly age a in the population at time t, and b(t) be the rate of new individuals being born at time t. Hence the fraction of the population between the ages a_1 and a_2 is $\int_{a_1}^{a_2} p(a, t) da$ and the number of new individuals created in time interval t_1 to t_2 is $\int_{t_1}^{t_2} b(t) dt$. Let $\lambda(a) dt$ be the expected number of progeny of a single individual of age a in dt units of time, l(a) be the probability that an individual will survive from birth to at least age a, and c(a) be the infinitesimal death rate (i.e. the probability of death of an individual of age a within the next h units of time = c(a)h + 0(h)). From the postulate, an individual will survive from birth a + h units of time if and only if he survives from birth a units and then does not die in the next h units of time, it follows that

$$\frac{l(a + h) = l(a) (1 - c(a)h)}{dl(a)/da = \lim (l(a + h) - l(a))/h = -l(a) c(a)$$
(20)
h \rightarrow 0

and hence

$$l(a) = l(o) \exp(-\int_0^a c(s)ds), \ l(o) = 1$$
 (21)

Therefore the problem becomes; given the functions λ and c(l following from c), determine b.

Let $b_0(t)$ be the rate of new individuals due to individuals in the population at time t = 0, and $b_1(t)$ be the rate due to individuals born at time t > 0, i.e.

$$b(t) = b_0(t) + b_1(t)$$
 (22)

First $b_0(t)$ will be developed. Let *P* denote the conditional probability of survival to time *t* (i.e. to age = a + t) given an age of *a* at t = 0. Hence, **P** • prob(age $\ge a) = \text{prob}(\text{age} \ge a + t)$, i.e.

$$P = l(a + t)/l(a)$$
 (23)

Therefore the fraction of individuals of age *a* at t = 0 that survive to age a + t (i.e. to time *t*) is

$$(l(a + t)/l(a)) \rho(a, o)$$
 (24)

and summing over all ages gives

$$b_0(t) = m(0) \int_0^\infty \lambda(t+s) (l(s+t)/l(s)) \rho(s, 0) ds$$
 (25)

where m(t) is the total population at time t.

Next $b_1(t)$ will be derived. The conditional probability of survival of an individual to time t (i.e. to age $= t - \tau$) given his age was 0 at time τ is $l(t - \tau)$, the rate of new individuals at time τ is $b(\tau)$, and the rate of births from individuals of age $t - \tau$ is $\lambda(t - \tau) d\tau$. Therefore the rate of new individuals at time t due to individuals born at t > 0 within the time interval $d\tau$ is

$$\lambda(t-\tau) b(\tau) l(t-\tau) d\tau \qquad (26)$$

and on summing over all intervals of $d\tau$,

$$b_1(t) = \int_0^t \lambda(t-\tau) \, l(t-\tau) \, b(\tau) d\tau \qquad (27)$$

Therefore combining results in an integral equation for b(t),

$$b(t) = b_0(t) + \int_0^t \lambda(t-\tau) \, l(t-\tau) \, b(\tau) d\tau \qquad (28)$$

where, as we have seen, $b_0(t)$ is a known function of t depending on the total initial population, m(0), the initial age distribution, $\rho(a, o)$ and the functions λ and l(or c). The total population, m(t) and the age distribution are related by

$$m(t) \rho(a, t) = b(t - a) l(a), a \le t$$
 (29)

A solution of the integral equation may be obtained numerically by standard procedures.^{24, 25} The following procedure converts the problem to a differential equation. Let ϕ denote λl and expand ϕ into its Taylor series,

$$b(t) = b_0(t) + \int_0^t \phi(t - \tau) b(\tau) d\tau$$
(30)

$$= b_0(t) + \int_0^t (a_0 + a_1(t - \tau) + a_2(t - \tau)^2/2! + \cdots)b(\tau)d\tau$$

ere

where

ai =
$$(d^{i} \phi(s) / ds^{i})_{s=0}$$
; i = 0, 1, 2, ..., n (31)

Using the well known integral identity b(t) becomes,

$$b(t) = b_0(t) + a_0 \int_0^t b(\tau) d\tau + a_1 \int_0^t \int_0^t b(\tau) d\tau^2 + \dots + a_n \int_0^t \dots \int_0^t b(\tau) d\tau^n$$
(32)

and differentiating *n* time gives,

$$b^{(n)} - a_0 b^{(n-1)} - a_1 b^{(n-2)} - \dots - a_n b = b_0^{(n)}$$
 (33)

This is an inhomogeneous differential equation with constant coefficients. Initial conditions are provided by the values of $b_0(t)$ and its first n-1 derivatives evaluated at t = 0. This equation can be solved analytically where an appropriate approximation of the

particular solution is obtained for example, by evaluating,

$$\pi_{i=1}^{n} (D - r_{i})^{-1} b_{0}^{(n)}(t)$$
 (34)

where r_i are the characteristic roots of the differential equation and D is the differential operator D = d/dt. The author has developed analytical computer aided techniques that employ automatic algebraic and symbolic manipulation for solving such problems.²⁶ This equation could be numerically solved by traditional methods such as Runge-Kutta integration.²⁷ The accuracy of the solution increases with increased n but so does the labor of obtaining it.

(4) Simulation Solution

In this section b(t), and consequently, $\rho(u, t)$ and m(t), will be obtained by a computer simulation. These computations, as well as the above, have been performed on the Cleveland State University IBM 370/158 system. The solution by simulation permits the easy inclusion of features that would present enormous difficulty in regard to analytical or traditional numerical methods, for example, the selection of very complicated $\lambda(t)$ and c(t)which may be discontinuous. It should be noted that the accuracy of a solution by simulation is not subject to round-off error nor error of truncation but, instead, limited by the variance of the simulation.²⁸

Let f(u, t), be the frequency histogram, at time t, of individuals born in birth quantile u, (u = 1, 2, ...). Hence the age of an individual is a = t - u and $\rho(a, t)$ is the normalized continuous representation of the discrete f(t - a, t). It will be convenient to solve for f(u, t) directly instead of obtaining b(t) from which $\rho(a, t)$ follows. The initial distribution f(u, o) must be given. Instead of using b(t), $\lambda(a)$, l(a) it will be more convenient to use the related functions $\phi_b(a, u)$ and $\phi_d(a, u)$, which are, respectively, the probability of birth (possibly multiple) from an individual of age a and born in birth quantile U, and the probability of death of an individual of age a who was born in birth quantile u. Let $w_d(a, u)$ be the probabilities of i offspring given that a birth occurred, and require that

$$\Sigma_{i} w_{i}(a, u) = 1 \tag{35}$$

The following correspondences with the continuous functions of the previous section result:

$$\lambda(a) \leftarrow \Sigma_{i} iw_{i}(a, u) \equiv S(a, u)$$

$$b(t) \leftarrow f(a, t) \phi_{d}(a, u) S(a, u)$$

$$l(a) \leftarrow 1 - \phi_{d}(a, u)$$
(36)

The specification of f(u, o), $w_i(a, o)$, $\phi_b(a, u)$ and $\phi_d(a, u)$ completely specify the simulation. Some of the details of the simulation are indicated by the flowcharts in Figure 1. These computations develop the 2-dimensional histogram, f(u, t), by calling upon the procedures BIRTH and DEATH, which, respectively, simulate births and deaths by returning a correction, Δf , to the current value of f(u, t). The final 2-dimensional histogram for f(u, t) is obtained by averaging many applications of procedure POPULATION.

The simulation just described has been applied to the *only* data on the initial and early peopling of the world, i.e. the data of Genesis 10 and 11. Let time t = 0 repre-

sent the birth of Shem, Ham and Japheth and their wives, all of which, for simplicity, will be assigned to birth quantile u = 1 at t = 0 at 100 years before the Flood (Gen 5:32, Gen 7:6-11; Gen 8:13, Gen 10:1, Gen 11:10).

This assumption is probably close to fact; and various other distributions of the original six produce similar f(u, t) from the Flood onward in time. Since no mention is made of additional offspring of Noah and his wife, they are not included in the original population. These arguments suggest

$$f(u, o) = \begin{cases} 6, u = 1 \\ 0, u > 1 \end{cases}$$
(37)

In order to include the effect of the very large longevity that decreases continuously and rapidly to a limiting life span of 70 years (Ps 90:10, David's 70 years 2 Sam 5:4, 1Kg 2:10), let T(u) denote the life span of the post-Flood population and let

$$\phi_{d}(a, u) = \begin{cases} 0, \ 0 \le a \le a_{1} \\ a/T, \ a_{1} \le a \le T \\ 1, \ T \le a \end{cases}$$
$$\phi_{b}(a, u) = \begin{cases} 0, \ 0 \le a \le 20 \\ c_{b}, \ 20 \le a \le .5T \\ 0, \ .5T \le a \end{cases}$$
$$T(u) = 70 + 600 \ e^{-u/200}$$
(38)

T(u) is an exponential function whose form attempts to fit the longevity data of Genesis 11.²⁹ T(u) depends only on the time of birth of the individual as might be expected when considering the debilitating effect on developing organisms due to the increasingly harsh global environment after the Flood.¹

Rapidly increasing ultraviolet radiation and the decreasing terrestrial magnetic field are two possible reasons for this debilitation. Reference 30 is especially significant in associating longevity solely with the time of birth. The choice of $\phi_{d}(a, u)$ reflects the increased probability of death as time increases while the selection for $\phi_{b}(a, u)$ attempts to incorporate the shortening reproductive period.

It is convenient to make no distinction between male and female; or else to take three as the initial population and choose a male-female pair as the individual. These two treatments are conceptually and mathematical equivalent; the latter case yielding half the actual total population. The reproductive period has been set at between 20 years of age; and half the individual's life span during which time a birth occurs with constant probability c_b .

The most sensitive parameter of this simulation is clearly c_b . If c_b is assigned $c_b = 0.1$ then this may be understood as there being, on the average, one birth (possibly multiple) per each 10 year period (within the reproductive period) per individual. The probabilities of multiple births will be taken as constant, specifically,

$$w_1 = 1, w_2 = w_3 = \dots = 0$$
 (39)

The value a_1 will be conservatively assigned as zero in all computations.

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Table 1 shows the result of the simulation for the above definitions with $c_b = 0.5$. Similar numbers result for $c_b \ge 0.2$. For $c_b = 0.1$ the population dies out but for $c_b = 0.15$ the population grows to 2.1×10^6 by 200 years after the Flood.

A time argument value of t = 300 corresponds to 200 years after the Flood, the Flood having been assumed to occur 100 years after the beginning of the simulation. During this time the world was greatly and quickly repopulated while concurrently losing its ability to do so.

Only a general population growth model, such as this one, could accommodate these conflicting developments. The total population of $m(300) = 6.2 \times 10^7$ strongly indicates that the world could, indeed, be greatly repopulated by 200 years after the Flood and that, consequently, geneological gaps need not be assumed in the record of Genesis 10 and 11, at least, on the basis of otherwise insufficient world population. Figure 2 shows the variation of m(300) and m'(300)/m(300) versus c_b .

Clearly, m(300) strongly depends on c_b . Before embarking on arguments for assigning the value of c_b , let it be noted that changes in the forms of T(u), ϕ_b and ϕ_d do not sensibly change the order of magnitude of the outcome of these numerical experiments. In fact, most plausible changes would increase m(300).

For example, increasing a_1 and decreasing w_1 (i.e. increasing the w_i , i > 1) might increase m(300) by a factor of 10 if a fairly high frequency of multiple births is permitted. Changing the three constants in the expression for T(u) throughout a large range of values has little effect on the outcome. The constants in the expression for ϕ_b (i.e. the 20 and 0.5) have an observable effect on m(300), but an effect that is smaller than the sensitivity of the outcome on c_b .

However, the dependence on the width of the reproductive period would be similar to that on c_b . A PL/1 program listing of the simulation in Figure 1 for the expressions of the text (but using two years and a male-female pair as units) is available from the author.

A value of $c_b = 0.3$ and $w_1 = 1$ is equivalent to postulating a single-birth within every 3.33 year period within the reproductive period. This has been approximately the case for overpopulated areas at the present time. Large infant mortality has suppressed the recent world population growth. One need not assume such infant mortality in the immediate post Flood era.

Furthermore, at the present time many ethnic groups such as the Hutterites of Canada, the Old Order Amish of Ohio, and the French Canadians of Quebec, to name a few, nearly possess this reproductive rate. It has been suggested that the main contributing factor for the successful conquests of the Vikings was a population explosion. This may have been commensurable to assigning $c_b = 0.3$. Many other historical examples can be cited. A conservative value of $c_b = 0.175$ (a birth every 5.71 years) yields a sufficiently large m(300) to demonstrate the thesis of this paper.

If a high frequency of multiple births is permitted then a vastly higher population growth occurs. If $c_b =$ 0.3, $w_1 = 0.9$ and $w_2 = 0.1$ then, roughly speaking, an effective c_b , \overline{c}_b , of 0.3 (1 × 0.9 + 2 × 0.1) = 0.33 results. Even an increase in c_b of 10% stimulates population growth by about a factor of about 1.12. It is easy to see that if twins, triplets and even higher multiples are permitted then it is not unreasonable to expect $\overline{c}_b = 1.5c_b$ which, by Table 1, corresponds to an increase in population by a factor of about 1.7. Increase of the width of the reproductive period would similarly effect c_b .

It is interesting to speculate on whether or not the Biblical record of the post Flood period or non-Biblical sources for this time support a high frequency of multiple births, i.e. is the ratio \overline{c}_b/c_b substantially greater than 1.

The geneological information from Genesis 10 to the end of Genesis includes about 250 names (Gen 10, 11, 22, 25, 36, 46, 50) which comprises only a partial list

Table 1. The population distribution every 20th year since the Flood grouped into 20 year intervals of birth quantiles. Column 1 contains the average number of first parents. Columns 12 and 13 contains the total population, m, and the relative fractional population growth. $c_b = 0.5$, $w_1 = 1$.

	20 year intervals of birth quantiles. u.												
	1	101-120	121-140	141-160	161-180	181-200	201-220	221-240	241-260	261-280	281-300	m	m /m
0	6.00	0	0	0	0	0	0	0	0	0	0	$6.0 \cdot 10^{0}$	-
20	6.00	3.0·10 ⁰	0	0	0	0	0	0	0	0	0	$2.4 \cdot 10^{2}$	5.0.10-2
40	3.82	3.0	1.8•10 ⁴	0	0	0	0	0	0	0	0	$1.8 \cdot 10^{4}$	5.0
60	1.20	3.0	1.8	$8.8 \cdot 10^{5}$	0	0	0	0	0	0	0	$1.0 \cdot 10^{6}$	5.0
80	0.26	3.0	1.8	8.8	8.6·10 ⁶	0	0	0	0	0	0	8.4	4.4
100	0	3.0	1.8	8.8	8.6	8.4•10 ⁶	0	0	0	0	0	$1.8 \cdot 10^{7}$	2.8
120	0	3.0	1.8	8.8	8.6	8.4	$1.1 \cdot 10^{7}$	0	0	0	0	2.9	1.5
140	0	2.2	1.8	8.8	8.6	8.4	1.1	9.0 • 10 ⁶	0	0	0	3.9	1.3
160	0	1.1	1.4	7.0	8.6	8.4	1.1	9.0	$1.1 \cdot 10^{7}$	0	0	4.7	8.5 • 10 - 3
180	0	2.4•10 ¹	4.6•10 ³	5.2	7.6	8.4	1.1	9.0	1.1	9.2•10 ⁶	0	5.4	7.4
200	0	3.8•10 ⁰	1.1	1.5	4.4	8.4	1.1	9.0	1.1	9.2	8.5·10 ⁶	6.2	6.8
	1	2	3	4	5	6	7	8	9	10	11	12	13

of, essentially, only male offsrping. Of these names only Esau and Jacob (Gen 25:24), and Pharez and Zarah (Gen 38:27) are stated to be twins, which would indicate only a $w_2 = 2/246 = 0.008$. A detailed search of the geneological tables of Genesis would suggest several cases which might be at least twins, e.g. Peleg and Joktan (Gen 10:25), and Buz and Huz (Gen 11:21). On this basis one might conjecture a $w_2 = 0.1$.

An even larger w_2 , and even significant values for w_3 through w_6 , is suggested by the Talmud. Herein the commentary on Ex 1:7 holds that sextuplets were common and observes that the word for "multiplied" pertains to reptilian reproduction whereby multiple births were the rule. In this case a large \overline{c}_b/c_b would not be difficult to substantiate.

The King James Version indicates this distinction, implicit in the Masoretic text, by using the word "fill" in Ex 1:7, as in Gen 1:22 in distinction to "replenish" in Gen 1:28 and Gen 9:1. The word "fill" meant to stock a volume (i.e. the sea and air) with animals, whereas the word "replenish" specifically is used to indicate stocking a land area with humans.³¹

It is not clear as to whether or not such fecundity can be imputed to previous generations; for, at least, it is clear that the descendants of Mizr (the Egyptians) were not as prolific as the descendant of Eber (the Hebrews). Some have even argued for the possibility of Cain and Abel being twins.³²

The argument for a large population growth after the Flood does not, however, depend on frequent multiple births. This would only strengthen the argument; as would other assumptions such as assigning a non-zero value to a_1 , including Noah and his wife in the initial population, or increasing the duration of the reproductive period to beyond half the life span. Though it be supernatural, the case of Sarah (Gen 17:7, 21:5) would suggest substantially increasing the upper limit from 0.5T. Sarah's outstanding beauty, even in her old age (Gen 20), may further indicate how long the prime of life lasted.

The Abrahamic Promise, though it primarily applies to events far removed from Abraham's time, might be taken to indicate the especially rapid population growth in those days, in that the number of descendants of Abraham are likened to the "dust of the earth" (Gen 13:16), the number of "the stars" (Gen 15:5), and "the sand which is upon the sea-shore" (Gen 22:17).

A few comments on the arithmetic of the simulation are required. The random number generator used has been the well-tested power-residue generator.^{28, 32} A population simulation is a simulation on the positive integers; however, in the computations of Figure 1 fractional numbers result. Two procedures have been tested: retaining fractional numbers in that they represent the average of many such numerical experiments, or always rounding off to the nearest integer. Tests indicate no substantial difference between these two modes.

Population Mathematics and Biblical Research

A number of mathematical tools are potentially useful for demographic and population studies associated with Bible research. A few have been

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Figure 1. A brief flowchart indicating the simulation of f(u, t). $t_{e \text{ is}}$ some terminal value at which the simulation is terminated. R is a uniformly distributed random number between 0 and 1 which has been provided by the usual residue calculation.²⁵ $w_0 = 0$. t_s is the time at which population growth commences, which has been assigned the value of 100 as argued in the text.

detailed here, i.e. Kendall's solution of the inhomogeneous birth-death process, Karlin's deterministic model with the solution method suggested herein, and the use of simulation. More detailed studies should not exclude the work of Harris, Galton or Bellman (see bibliographies of references 16, 17, 23), or the application of the Volterra population equation.^{34–36} The state of the art of the theory of age-dependent branching models is represented by the work of Savits.^{37–39} Savit's theory generalizes the Bellman-Harris model to include all the complexities required by the problem of this paper;³⁷ however much research will be required in order to solve Savit's equations.

Similar anlayses could be applied to the growth of the ancient Assyrians, Babylonians and Persians, for exam-This would be of value to secular, as well as ple. Biblical, research. The author knows of no such attem-It seems that secular historians, anthropologists pts. and archeologists have used little quantitative analysis. This is not surprising, since they disregard or make light of the Bible as a source of data, thus ignoring the only record of the most ancient times and of beginnings, which, in fact, is an infallible inerrant record, and which uniquely provides much census and demographic information over such a long span of history, e.g. Gen 10:11, Num 1-3, 31-34, Josh 15-19, 2 Sam 24, 1 Chron, Ezra 2, Neh 7, and Est 9.

In addition to analyzing the population growth after the Flood it would seem worth while, likewise, to study the demographics of this population as it spread forth from Mt. Ararat (Gen 8:4) with discontinuity at Shinar (Gen 11:2). Very little quantitative research in this area has been done although extensive qualitative ⁴⁰⁻⁴² and

some semi-quantitative 43 is available. References 44-46 are worthy of mention.

Conclusion

The curves in Figure 2 may be regarded as lower bounds for a given c_b . Hence values of $c_b \ge 0.175$ (roughly, a single birth within every 5.71 year interval of the reproductive period) result in values of m(300)(i.e. the world population 200 years after the Flood) from 10^7 to 10^8 , provided the assumptions of the simulation model are sufficiently correct. Similar results have been obtained from analytic studies, thus verifying and strengthening the final conclusion: that a population on the order of millions *could* result shortly (e.g. 200 years) after the Flood. As a corollary it may be stated that, based on the data of Genesis 10 and 11, such population growth *did* result.

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PANORAMA OF SCIENCE

Specialization is not Necessarily Dangerous

A common evolutionary explanation of extinction has been that creatures evolved, becoming more and more specialized. Eventually they reached a point at which they were too inflexible; then they became extinct.

However, doubt has been cast upon this notion. In a recent letter it was stated: "That specialised taxa tend to become extinct is . . . (an) . . . assumption of evolutionary biology . . . test of the extinction through specialisation hypothesis, however, failed to distinguish any significant correlation between specialisation and evolutionary longevity within aquatic free-living arthropods."¹

An article, by Cisne, J. L. 1975. (in) *Evolution*, Vol. 22, pp. 337-366, which I have not seen, was cited.

It would appear that the notion mentioned is another one of those which have been taken for granted, with little or no real evidence, and which are badly in need of reconsideration.

More Evidence of Plants in Supposedly Old Rocks

It has been noted in the *Quarterly* that traces of plants quite similar to modern plants are found, and have been found for years, in rocks called as old as Cambrian. I have come upon a reference which shows that this is not a very recent discovery. Berry, writing in 1927, mentioned coal, or metamorphosed coal, indicating plants of some complexity, underlying the Gogebic in Wisconsin, and in the Sudburyian series at Chelmsford, Ontario.² He seemed to consider them pre-Cambrian. Later, in response to criticism, he reiterated his findings, and urged that ". . . we are forced to believe in a pre-Cambrian terrestrial flora of relatively high organization . . ."³

Why is it, one may wonder, that even in 50 years evidence of this kind has not been included in textbooks?

Petroleum Need Not Be Very Old

The fact that petroleum can form very quickly, so that its existence does not necessarily indicate any great age for the Earth, has been mentioned in the *Quarterly* from time to time. Some experiments have been reported which show that the necessary changes can indeed be quite fast.

Kerogen, humic acid, and lipid material from marine sediments were heated at $150 \,^{\circ}\text{C} - 410 \,^{\circ}\text{C}$ for 5-120 hours. Tests of the results showed that: "... the distribution pattern approached that of petroleum hydrocarbons... other organic sediment fractions (lipid and humic acid)... also have an ability to produce pariffinic hydrocarbons..."⁴

Incidentally, on the subject of the origin of petroleum, I recently came across a paper in which the author maintained that at least a considerable portion of petroleum might have originated from carbon inside the Earth, not from formerly living things at all.⁵

Another Anomaly of Carbon 14

Usually carbon 14 has been applied to living, or formerly living, things. However, there have been other applications, and one of these has been to groundwater, which contains carbonates. The groundwater, of course, could easily contain carbon from carbonate rock, as well as from the atmosphere; and the surrounding rocks contain very little carbon 14. Thus the groundwater can be much poorer in carbon 14 than would have been expected at first. In fact, were corrections not made, ages as much as 10,000 years too great would be found for some groundwater.⁶

Is it not possible that some of this effect with the groundwater might transfer, so to speak, to formerly living things lying in the ground, so as to make them, too, indicate too great ages when investigated with the help of carbon 14?

Any Dating May Indicate Too Great Ages

Often creationists have found that the method using carbon 14 indicated too great ages for remains dated in that way. It is true, however, that occasionally carbon 14 has indicated that an age, estimated by some other method, was too great. Another example of this has been found.⁷

It is reported, in fact, that: "... the Ban Chiang (in southeastern Asia) painted pottery, thought on the basis of thermoluminescence dates⁸ to be more than 6,000 years old, is now found by radiocarbon dating to be no older than the first millennium B.C."

Is the lesson not that any way of estimating these ages can give wrong results? So a creationist need not be disconcerted at any reports of great ages; he can believe that a more accurate method would show the things to date to within the span of time allowed by Scripture.

Variations in Carbon 14

Another piece of evidence to show that the content of carbon 14 in formerly living things has varied in the past has been reported. Picks, made from the antlers of red deer, and supposed to be about 4,000 years old, were found in the remains of neolithic flint mines, at Grimes' Graves, Norfolk, England. The ages for the antlers indicated by carbon 14 varied over a range of about 300 years. But from other evidence it was concluded that the picks all belonged within a few years of one another.⁹

Evidence For A Young Solar System Confirmed

The evidence for a young Solar System provided by the existence of dust in the System has been discussed before in the *Quarterly*. Briefly, various effects of the Sun's radiation, and especially the Poynting-Robertson effect, would either sweep the dust out of the System or draw it into the Sun.¹⁰

Certain people have disputed these conclusions, but the author of a recent authoritative article has concluded that the original findings were about right. In fact, the System should be swept almost clean in about 10,000 years.¹¹

Some interesting points were made about comets. Almost all of the short-period comets have direct orbits. This would be very strange if the comets came into the System from outside at random. The author suggested that this is due somehow to the influence of Jupiter; a creationist is not surprised that they were created that way.

There is the interesting speculation that the influence of the planets on the interplanetary dust affects the rate at which that dust falls into the Sun. That, in turn, affects the Sun's activity. Thus there might be a correlation between the positions of the planets and solar activity, as some have thought. The author admitted, however, that that point needs more study.

-Contributed by Harold L. Armstrong

Whale Skeleton Found in Diatomaceous Earth Quarry

The recent report of the discovery of a fossil skeleton of a baleen whale in a diatomaceous earth quarry in Lompac, California, should be of unusual interest to creationists.

The whale is standing on end in the quarry and is being exposed gradually as the diatomite is mined. Only the head and a small part of the body are visible as yet. The modern baleen whale is 80 to 90 feet long and has a head of similar size, indicating that the fossil may be close to 80 feet long.¹²

No comment was made concerning the implications of such a unique discovery. However, the fact that the whale is "standing on end", as well as the fact that it is buried in diatomaceous earth, would strongly suggest that it was buried under very unusual and rapid catastrophic conditions. The vertical orientation of the whale is also very similar to observations of vertical tree trunks extending through several successive coal seams.¹³ Such phenomena cannot easily be explained by uniformitarian theories, but fit readily into a historical framework based upon the recent and dynamic universal flood described in Genesis chapters 6-9.

-Contributed by Larry S. Helmick

The Homology Concept: Broken Down

In his interesting book on recent advances in the field of parapsychology,¹⁺ John L. Randall (a type of theistic evolutionist himself) argues that evolution would be inconceivable without imagining some interaction between Mind and matter.

Randall shows that an origin of life by pure chance and a general evolution by means of random mutations and natural selection only are scientifically impossible, and that one must assume the activity of a great Mind. He hesitates, however, to call this "Mind" God because he says,

The theologian attributes certain *infinite* properties to his God; he is described as omnipotent, omniscient, and of infinite goodness. Now the Mind which reveals itself in the development of life on this planet is clearly not omnipotent, otherwise it would have assembled perfectly designed organisms directly from the dust of the earth without having to go through the long process of trial and error which we call evolution.¹⁵

This is in fact a good condemnation of "Christian" evolutionism: the omnipotent God of the Bible *did* create perfect organisms directly from the dust of the earth! Apart from Randall's evolutionistic vantage point, however, his arguments against a purely mechanistic evolution process are quite interesting.

He quotes Sir Alister Hardy who described a number of phenomena which are difficult to account for in orthodox terms. Among them are the "homologous organs", which, says Hardy, are "absolutely fundamental to what we are talking about when we speak of evolution,"¹⁶ yet which now are inexplicable in terms of modern biological theory.

Corresponding morphological patterns might be interesting for evolutionists if the various structures were transmitted by basically the same set of genes, only varying, in different organisms, by gene mutations and therefore traceable to a common ancestor. However, homologous organs are now known to be produced by totally different gene complexes in the different species. Here, Randall quotes the distinguished embryologist Sir Gavin de Beer who wrote:

It is now clear that the pride with which it was assumed that the inheritance of homologous structures from a common ancestor explained homology was misplaced; for such inheritance cannot be ascribed to identity of genes...

But if it is true that through the genetic code, genes code for enzymes that synthesise proteins which are responsible (in a manner still unknown in embryology) for the differentiation of the various parts in their normal manner, what mechanism can it be that results in the production of homologous organs, the same "patterns", in spite of their *not* being controlled by the same genes? I asked this question in 1938, and it has not been answered.¹⁷

The whole idea of a fairly static gene-pool, which is maintained intact over long periods of evolutionary time and undergoes rare and minor mutations responsible for the slow changes in the development of organs, now has to be given up. As Randall quote from Dr. Thorpe:

Now it is suggested that these constant [gene] systems may exist only in our imagination and that the genetic control of the development of such homologous organs may shift relatively rapidly while the organ remains the same! This seems to me to raise a quite fantastic difficulty.¹⁸

But not only are homologous organs not controlled by the same or similar genes, they may also arise from totally different parts of the developing embryo. Sir Gavin de Beer again:

It does not seem to matter where in the egg or the embryo the living substance out of which homologous organs are formed comes from. Therefore, correspondence between homologous structures cannot be pressed back to similarity of position of the cells of the embryo or the parts of the egg out of which these structures are ultimately differentiated.¹⁹ (Emphasis in original).

Randall comments:

The notion of homologous organs is so fundamental that any doubt cast upon it must inevitably tend to undermine the whole structure of neo-Darwinian theory.20

-Contributed by W. J. Ouweneel

The Protostomia-Deuterostomia Theory

Currently most biologists hold an animal kingdom evolution model proposed by Bateson in 1866, and drawn as a single tree with two large branches. On the "echinoderm" superphylum branch of this bifurcation model are the main phylums Echinodermata and Chordata, and on the second branch ("annelid" superphylum) are phylums Annelida, Arthropoda, Mollusca and some others.

The term "Protostomia" (first opening) is given the "annelid" branch, for within this group the embryonic blastoporal opening indicates an area of the future The "echinoderm" branch is known as mouth. "Deuterostomia" (second opening) because the blastopore is the area of the future anus, and a mouth forms at the opposite or anterior end.

Other developmental characters, including cleavage patterns, types of larvas, as well as development of celoms, nervous systems and skeletons have been adduced in support of the Protostomia-Deuterostomia theory.

However, recent reevaluation of current supporting evidence and analysis of a variety of newer biochemical and physiological features, along with histological differentiation patterns, has led to what Soren Lovtrup calls a falsification of the theory.²¹ Lovtrup points out that there are overlappings among characters used to define the two superphylums and that these characters are not "good" taxonomically.

Also, on the basis of the Protostomia-Deuterostomia theory, it can be predicted that in a phylogenetic classification the chordates should have more features in common with echinoderms than with a phylum in the "annelid" superphylum, but his results negate this prediction.

In his analysis, Lovtrup utilized vertebrates (cyclostomes, fishes and in two cases, amphibians) to represent chordates, and from the "annelid" superphylum he chose phylum Mollusca. Functional characters used in the study were placed according to their presence or absence in the vertebrates, molluscs and echinoderms.

The echinoderms shared only three characters with vertebrates and three others with molluscs; whereas 51 characters (such as myoglobin, control of sexual maturation, regulation of chromatophores, structure of dermis, specialized blood cells and olfactory sense organs) were common to the vertebrates and molluscs.

The author points out that a close relation between vertebrates and molluscs is 10100 times more probable than between vertebrates and echinoderms. Additionally he notes that amino acid sequences in cytochromes c would place molluscs distinctly between insects (phylum Arthropoda) and vertebrates. However, in a subsequent paper, Lovtrup suggests some reasons for classifying vertebrates closer to arthropods than to molluscs.²²

It may be expected that, when Lovtrup's views become widely known by the biological community, there will be a decrease in evolutionary dogmatism regarding limbs of branching evolutionary dendrograms, and hopefully an increase in receptivity toward a many-tree (polyphyletic) model as proposed by Berg,²³ Kerkut,²⁴ and others.

—Contributed by Wayne Frair

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BOOK REVIEWS

The Cave Bear Story by Björn Kurtén. 1976. Columbia University Press, N. Y. 163 pages. Price \$8.95.

Reviewed by Douglas E. Cox*

Fossils of the extinct cave bear, *Ursus spelaeus*, occur abundantly in the caves of Europe. Kurtén, whose given name means "bear" in Swedish, writes an interesting account of cave bear discoveries, giving much background information bearing on the enigmatic extinction of the species at the end of the Pleistocene.

Fossil bones of the cave bear were reported as early as 1748, and discoveries of caves with incredible numbers of bear fossils occurred during the 19th century. One of the early investigators of cave bears was Rosenmüller, a German evolutionist who anticipated Lamarck. Due to considerable variations of skull shape and other features of cave bears, early investigators tended to classify the cave bear into several distinct species.

Early suggestions about the origin of bone caves included: (1) caves were formed in rocks that already contained fossil bones; (2) the bones were carried into the caves by the Noachian Flood; (3) the remains were brought into the caves by man, and (4) the animals came into the caves on their own account and died there. This last viewpoint was proposed by Rosenmüller, who convinced Cuvier; and this is still the generally accepted belief, upheld in this book.

Cave bears were generally much larger than bears of the present time. An interesting feature of the skulls of many cave bear is doming or a "step" in the forehead, something like that which is present in the skulls of early man. This feature, called a "glabella," is not present in all skulls of cave bear however. Large sinus cavities are present behind the bulge.

The effective design of cave bear jaws and teeth suggests purpose, although this teleology is considered in the context of natural selection. The pivot of the jaw joint is raised above the occlusal plane of the cheek teeth, so that the jaws resemble vice-grips. This feature and the shape of teeth suggest the cave bear was largely herbivorous.

Estimated size of the cave bear is about three times greater than the European brown bear, a fairly lean male weighing 1,000 lbs. The female was probably about half the size.

"Few extinct animals are known from such a great number of fossil remains as the cave bear," Kurtén says. In the account of the evolution of the cave bear, an extinct dog-like creature, *Ursavus elmensis*, is named as the ancestor of bears. Little is known of this animal apart from its teeth and jaws.

It is generally believed that the cave bear lived at the time of the Ice Ages. But many animals fossilized along with cave bear indicate a tropical environment. Interglacial periods are therefore proposed, in which many kinds of creatures flourished including elephants, hyena, hippopotami, horses, boar, great lions and leopards, as well as many smaller animals such as beavers, badgers and foxes. Lions, hyena and Neanderthal man are believed to have lived in caves along with cave bear. During the Ice Ages, all these species evidently managed to survive quite well, but for some reason many extinctions accompanied the end of the glacial period.

Considerable variation in skeletal features of cave bear occurs. Males differ from females, in tooth structure as well as size. Some dwarf species existed. In one Austrian cave, small bear fossils were concentrated in the upper strata. Cubs of cave bear are often represented.

The theory that man was involved in burial of bears in caves is discounted by Kurtén, who proposes instead that the bears actually lived in the caves. Cave art on the walls of bear caves depicts bear, sometimes as if an animal were being hunted and killed by spears. Few human implements are found together with the fossils, however. Some caves show evidence of visitation by bears, in the form of footprints and scratch marks in clay.

The theory of a "bear cult", involving ceremonial killing and burial of bears in caves, is not borne out in the case of the cave bear. Interest in bears historically has centered on the brown bear, rather than the cave bear.

Possible causes for the death of great numbers of bears in caves include accidents such as stonefall from the roofs of caves, diseases such as rickets, parasitic worms, or just old age in some cases. Over a period of 100,000 years, the death of only one bear every other year in a cave would require a population fluctuating in size between 1 and 4 individuals in a single cave.

Far from being flooded by bears, the cave bear range was quite sparsely populated at all times. And so the natural history of the cave bear is taken out of the fantastic and returned to the realm of reality and credibility.

While the term cave bear properly refers to the extinct bear found in the caves of Continental Europe, a quite unexpected fact is that the fossil bears in British caves resemble the brown bear of today. "And yet we find the British bears violating the code of brown bear behaviour and denning in caves."

In North America, large Florida cave bears resemble the Andean bears living today, which are the last survivors of a species that ranged over most of the Americas in the Pleistocene.

The Florida species, *Tremarctos floridanus*, ranged over the southern United States and Mexico. This bear closely resembles the cave bear of Europe. "The bodily resemblance of this American species to the European cave bear is almost uncanny."

This resemblance is cited as an "amazing convergence" in evolutionary development. Yet the Florida species is not confined to caves, although some fossils occur in caves.

Another extinct North American bear was Arctodus, a huge animal exceeding 1,300 lbs. Some remains of these bears have been found in caves, but "mostly, however, the great Arctodus bears are found at open-air

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sites, and in such circumstances they range from Mexico to Alaska."

Discussing the cause of extinction of the various species of cave bear, Kurtén cites "loss of adaptation due to genetic drift" as a possibility. It is thought that the burials of bears in caves lasted throughout the Ice Age, and that the bears, as well as many other species of the Pleistocene, became extinct during the climactic changes at the end of the glacial period. It is conceded, however, that the problem of the cause of extinction remains unsolved. "Perhaps we have to wait for a new way in which to view the problem."

Creationists may regard the mass burial of bears as an effect of catastrophic sedimentation at the time of the Noachian deluge. The abundance of fossils in caves could be due to the formation of caves by disintegration of rocks that contained buried animals.' Citing this early view that caves were formed in rocks which already contained fossils, Kurtén notes:

This theory may sound fantastic and, in the case of the bear caves, it is so, but as a matter of fact it is not unusual to find petrified bone eroding out of a rock matrix.

If the bears and other Pleistocene animals were buried during the flood, and the caves formed by disintegration during uplift of the continents, the occurrence of bears and other animals in caves would not imply they actually inhabited the caves in which they occur as fossils. The deluge, and disintegration of sediments containing drowned animals massed together in the manner sometimes proposed for trees that formed the great coal beds, may be the key to understanding the extinctions of the Pleistocene.

The Cave Bear Story contains much factual information for creationists to think about, some helpful maps, diagrams and illustrations, and is well documented.

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¹Cox, D. E. 1976. Cave formation by rock disintegration, *Creation Research Society Quarterly*, 13(3):155-161.

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Creation: A Scientist's Choice by Zola Levitt. 1976. Victor Books, Wheaton, Illinois, 60187, 131 pp. \$2.25.

Reviewed by G. Richard Culp*

This is a different kind of creationist book, as it unfolds the teaching of one of our more widely known proponents of this doctrine, in the words of one who came to see the truth of special creation through his teaching. The book thus follows the author's progress from doubt to full commitment as we read from chapter to chapter.

Professor John Moore, of the Department of Natural Science at Michigan State University, whose observations and convictions are expounded in the book, has presented the creationist position in a most commendable fashion. He begins by showing why this issue is of utmost importance to the Christian, as evolution has spawned a secularism and agnosticism that is growing world wide.

It is affecting many facets of our society, for the crumbling moral standards that we see on every hand reflect back to a defiance of the Holy precepts of God's Word, which the evolutionist has told us can now be safely treated as folklore. The monstrous systems of fascism and bolshevism are rooted in this very defiant agnosticism.

He likewise indicates why it is important in God's sight, as compromise on this issue produces an uncertainty, and without the certainty of God's divine precepts, we can have no spiritual regeneration, nor true discipleship. This reviewer feels that the very pillars of our faith such as the crucifixion, the resurrection, and the eternal states of heaven and hell thus tend to become hazy and fade into uncertainties, to one who begins to choose what part of Scripture he will believe—and what part not to believe.

Professor Moore seems to be fair throughout the discussion, even explaining why evolution is attractive to students. For instance, it seemingly explains extinct animals; and it satisfies man's tendency toward spiritual unbelief. But in truth it is creationism that is consistent with all scientific disciplines.

He gives many examples to illustrate that much of science is actually theoretical, i.e., not based directly on observation. But the best of these theories, such as the atomic theory, are based on experiments which can be repeated at will. This is quite in contrast with the evolutionist position.

He deals pointedly with some of the supposed evidence for evolution, and presents the evidence for a great catastrophic flood as the most scientifically plausible explanation for fossil forms. He likewise presents evidence for a young earth, and shows why this is so damaging to the evolutionist theories which would need millions of years to explain great changes in structure. He considers next the supposed flaws in the creationist position, and shows how the latter is actually consistent with the best scientific evidence.

His logic is impeccable, and is given with an easy grace and fairness that commends the Christian position. This is especially evident in his debate with an evolutionist in the Michigan State Teacher's Bulletin.

Van Deventer, the evolutionist, on the other hand distorted the account of the Scopes trial in Tennessee, claiming that Bryan died of a heart attack during the trial (it was five days afterward), that "the results were inconclusive", and that "later the law was repealed." Actually, this is one of the few trials in which Clarence Darrow could not control himself,¹ and came out empty-handed. The verdict in fact went squarely against Scopes, and the ban on evolutionist teaching continued on the statutes of The State of Tennessee for many years, being rescinded relatively recently.

Professor Moore on the other hand gives decidedly clear reasoning in defending our historic separation of church and state, and shows that the teaching of evolution alone in public schools is a unilateral program of indoctrination of the theories devised by

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agnostics, which ignores the convictions of parents and the training they have given their children.

His discussion on redemption (p. 84) is brought in nicely. It would have perhaps been well to include also the importance of the Christian life after the experience of regeneration.

This book should be one of those that we should have on hand to give to the youth of today who are searching for something real, with a firm foundation. Both the content and the price commend it for this purpose. It is possibly a little advanced for junior high school students, as well as some high school students, but it should be an excellent source of information for college students and the high school students who have been most affected by evolution.

The last 40 pages contain many interesting charts which reflect Professor Moore's logical mind, and help to explain why his course is so interesting to his college students. An index might well have been included.

I can highly recommend the book, hoping that it enjoys a wide circulation, and that it proves to help many of our youth through the gates of the Kingdom.

Reference

¹Sann, Paul 1957. The lawless decade. Bonanza, New York, pp. 122-123. Sann reports that, among other things, Darrow accused Bryan of "insulting every man of science and learning in the world because he does not believe your fool religion."

(Editor's Note: Since *Creation: a Scientist's Choice* is of considerable interest to creationists, and since the two reviews deal mostly with different aspects, a second review is presented.

Reviewed by Walter E. Lammerts.[†]

Here is a book about how the managing editor of the *C.R.S. Quarterly*, John N. Moore, convinced Zola Levitt, a "secret" evolutionist (though Bible-believing) that creation is a more objective explanation of origins than evolution.

The five hour interview with Moore and later sessions of amplification and illustration are presented in a very understandable and interesting manner.

It is pointed out that one's personal and collective behavior is determined by whether he believes that men are only highly developed animals, or the personal creation of a loving God. Human totalitarian societies commit deeds worse than animal behavior. The latter do not overkill, or gather more than needed and thus control the lives of those dependent on them, as so many human capitalists do.

Evolution minded paleontologists interpret the fossilbearing stratified rocks as showing a sequence of increasing complexity. The resemblances of the embryos, internal body systems, and skeletons are supposedly due to evolution from a common ancestor. Natural selection of variations was Darwin's mechanism for species transformation. But Levitt points out in the chapters, "Facts about a "Theory'," that actually there is no complete "geological column" showing a continuous progression from very simple creatures to very complex ones. Often there are strata with relatively simple fossil species on top of those with very complex ones. Connecting links of fossil forms are not found either. Mutations, the only variations available for natural selection are defects; and also they do not introduce any new traits, but only modification of existing organs.

No intergradations exist between the various groups of organisms, or indeed between species, which reproduce with an amazing fixity of form except for minor details. As Levitt says, "... the incredibly complex interrelationships of environments and intricately formed creatures, must have come from a "Master Plan" or at least from a purposeful Designer." (page 37)

There is a most interesting chapter on the present public debate and how associate members of the Creation Research Society beginning in 1963 succeeded by 1969 in getting the creation concept of origins into the public school textbooks of California. The Institute for Creation Research, of which John Moore is a consultant, sponsors seminars for teachers, parents and pastors.

Levitt's final message is that every one should read the Bible and act on its main message that Jesus Christ is the Creator of all this marvelous complexity of life. He also made each one of us for a purpose, so we should love and praise Him, doing our best to follow His teachings.

As with all books there are some points which could be more clearly stated. Thus on page 32, Levitt states, "We do know as a fact that the DNA molecule varies with the species." Actually it is the arrangement or sequence of the DNA molecules or nucleotides which vary with the species.

And though correctly stated on page 26, the statement on page 19, "Certain strains of bacteria and flies appeared which were resistant to penicillin and DDT" is unclear. A better statement would be: "Certain strains of bacteria and flies seemed to be induced which were resistant to penicillin and DDT, after exposure to these chemicals. As will be shown later they already existed and it only seemed that the fittest were surviving."

I do not believe, though, that communism resulted from evolutionary concepts. Rather it or its spread, was the result of the horrible oppression of the common people by the Czars and ruling classes in Russia. Likewise in this country capitalism as late as 1890-1910 was very harsh, forcing workers to labor 12 hours per day for a mere pittance, often under the most unhealthy and dangerous conditions. Fortunately, progressive capitalists such as Henry Ford and legislators such as Robert Marion Lafollette gradually modified capitalism reducing the length of the working day, improving working conditions, and increasing the workers' share of each company's income.

Finally, I cannot concede that the classification of plants and animals is arbitrary. (page 19). When properly done it shows God's plan of biological creation, and indicates the relative degree of similarity

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both externally as regards form and internally as regards the DNA sequence.

The statement that unearthed cities clearly prove the existence of Abraham is indeed interesting and I hope that the next edition will give the reference for this so that we can learn more details regarding this further verification of the Bible's accuracy.

Various appendices such as "Living Fossils", chromosome counts in plants and animals, and comparison of man versus ape are given.

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Trinity in God and Trinity in Nature by Joseph K. Smolen. 1975. Carlton Press, Inc., New York. 47 pages. Price, \$3.00.

Reviewed by H. L. Armstrong*

St. Patrick is said to have illustrated the fact of the Trinity by the three-fold leaf of a shamrock. Likewise, in this book the author, an electrician, uses as illustrations several three-fold things from nature, and especially electricity. For electricity, he points out, can be considered in three aspects, as, indeed, it commonly is in textbooks, viz.: static electricity, current electricity, and electromagnetic phenomena. Yet nobody doubts that there is a unity to it.

The illustration can be carried further, as the author does on pages 31 and 32. Two or three hundred years ago, natural philosophers listed and discussed quite a number of kinds of electricity, which were later seen to be different aspects of one phenomenon. Just so, it is suggested, in primitive conditions men noted many aspects of God's activity, and ascribed these to many gods. But now, with the help of Revelation, those who will can see God's unity.

Not only are there arguments, but also there are instructions for making some little electrical demonstrations, which may be of interest.

This book would be especially useful to the teacher of Sunday School, or anyone having similar contact with young people. For most young people have heard something of science, including electrical science; and illustrations drawn from it may well be among the clearest to them.

Portraits on Nature's Palette by Willis E. Keithley. 1975. Available from the author at 1819 N. W. 25th, Lincoln City, Oregon 97367. 196 pages. Price \$6.50 for hard cover, \$4.50 for paperback.

Reviewed by H. L. Armstrong*

Readers of the *Creation Research Society Quarterly* have seen photographs of natural things, often with a commentary, which Willis Keithley has contributed from time to time. Now about 127 such photographs, some of which have appeared in the *Quarterly* have been gathered into one volume. The pictures actually have to do with about 70 different topics, and for each topic there is about two pages of commentary. The commen-

tary often includes some little known facts from the study of nature; and there is always a Christian message, to which the photograph serves as a text, so to speak.

This book would make an excellent gift to anyone who is interested in nature, or in photography. It could be useful also to a Sunday School teacher; and, indeed, it deserves a place in the books of any school, among the works of Nature Study. This reviewer hopes also that it will be put into many public libraries.

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Bone of Contention by Sylvia Baker. 1970. Evangelical Press, Grand Rapids, Michigan.

Reviewed by David J. Rodabaugh*

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This well-written book presents in a short space quite a bit of evidence against the theory of evolution. Evidence is presented from the fossil record, genetics, and dating schemes.

The fossil record is used to show that there are gaps in the presumed history of animal kinds that are contradictory to what the evolution model requires. In addition, fossil graveyards give evidence of a catastrophe such as the flood in Genesis. Giantism in the fossil record is also mentioned though more documentation on this point is needed both from science and the Bible. That there are man-like giants in the Bible is clear but some creationists attribute their existence to other than natural causes.

The laws of genetics are shown to not allow evolution's presumed mechanism. Indeed, natural selection is shown to deplete the gene pool, contrary to what is needed for evolution. A unique discussion is the author's personal testimony. She became convinced that evolution was unscientific when she and her classmates tried to explain the evolution of the eye.

The dating schemes used by evolutionists are shown to be unreliable when used to date the age of the earth. Six dating schemes are mentioned that imply a young earth.

The book opens with something unusual for a short book—a summary of the history of evolutionary thought. Several reasons are given as to why evolution prevailed in the scientific community. Some of these are instructive to creationists.

First, there was Bishop Wilberforce's apparently unwise performance at a scientific meeting. He seems to have been uninformed and to have substituted scorn for reason. Such is not the way to present creation. Second, there were many Christians who compromised their position—always a dangerous thing to do. Third, there is the confusion of the term "species" with the Biblical "kinds". That these are not the same is crucial in defending creationism.

The author correctly emphasizes that Christians may concede that one species might change, but must vigorously fight the view that this process can change toward greater complexity.

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There are two minor drawbacks. While books for further reading are listed at the end of each chapter, explicit statements are rarely documented. Such documentation would be useful to a reader who wished to present some of the facts in this book.

Another problem is that a general creation model is not discussed—the author limits the discussion to the Biblical creation model. In some situations (like U.S.A. public schools) this would limit the distribution of an otherwise very excellent book. This book includes a number of good, appropriate illustrations. It is very well-written and contains a good bibliography. The compact size (only 33 pages) commends it to some busy readers who need an introduction to the case against evolution. In fact, this is a delightful book that each creationist will enjoy and that each evolutionist should consider.

(Editor's Note: This fine publication may be obtained most directly from Puritan Reformed Discount Book service, 1319 Newport Gap Pike, Plaza 41, Wilmington, Del. 19804 for \$1.00 per copy, or \$9.65 per dozen.)

LETTERS TO THE EDITOR

Creationist Principles in Medicine

The following portion of a letter sent to medical people might be of interest to readers of the *Quarterly* generally:

As with other sciences, progress in the field of medicine has been hindered by evolutionary presuppositions. Some years ago Walter Lang, Executive Director of the Bible-Science Association, asked me what aspect of medicine might show the most promise for demonstrating this fact and the superiority of a creationist approach.

Several possibilities came to mind, but nothing really gelled until I learned of a case of asthma that was actually cured through a metabolic form of therapy after 20 years of lack of response to the conventional regimens of internal medicine and allergy. Since then I have been applying these metabolic principles, which are not taught in medical schools, in my own practice of allergy and have been observing most gratifying results. This creationist approach is preventative in nature, slowing down, and even reversing whenever possible, the degenerative processes which lead to slow or unsatisfactory healing of acute conditions, to chronic diseases, to aging and to death.

Presently there are many non-creationist medical and para-medical people learning and applying these unconventional approaches with some measure of success. However, they are hindered in their progress by a lack of understanding and often denial of Scriptural principles. I feel that we creationists should be able to pick up this ball and run with it much more successfully.

At the creation convention in the Philadelphia area next August, we are hoping to develop a special part of the program devoted to creationist medical principles. In the meantime, we hope to develop a fellowship of creationist medical correspondents to contribute their ideas to an informal type of publication to be distributed among all who join this fellowship.

The letter concluded with a questionaire, in which those interested might indicate some of the details as to how they would prefer the fellowship to be arranged. It may be that at some future time it will again be of interest to report in the *Quarterly* on the progress of this project.

> Cordially in Christ's Service, Albert S. Anderson, M.D. CMCF, Bible Science Library 19 Gallery Centre, Taylors, South Carolina 29687 Received 18 January 1977

A Possible Explanation of a Martian Phenomenon

Although Buffalo's snows received national attention during the winter of 1976-77, it was very blustery in Rochester too. I chanced to note a phenomenon early in the winter which may have relevance for the stratigraphic markings observed on the Martian polar ice by the Viking orbiters.¹

The first heavy snowfall here fell under rather windy conditions. As a result 18-inch snow drifts formed in the front yard of our house (which faces north); but the ground within about a yard of the house remained clear. Now it so happened that the ground was bare.

The soil here consists primarily of a very fine silt, bordering on loam. It does not take much wind to create a dust storm. As a result the wind-sculptured slopes of the snow drifts were covered with a layer of this dust. The wind continued to blow but eventually dropped below the velocity where it could pick up the dust. As the air was fairly dry at the time the snow started to sublime.

Oddly enough, the dust did not remain uniform on to snow-bank but started to coagulate locally into points a fraction of a millimeter across. These, in turn, were arranged along lines parallel to the wind velocity. This resulted in a striated pattern which was strikingly reminiscent of the Viking photos of the Martian polar region.

Although no unconformities were observed (the snow drift had melted before the next snowfall) it is easy to

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imagine that an overhanging snow-cliff could collapse and change the wind pattern and/or the striation directions. Such collapse need not be "violent", but could proceed as a "curling" analagous to ocean breakers.

Since global dust storms are annual occurrences on Mars this does not at all seem as such an unlikely mechanism for production of the striations. Since these observed Martian "beddings" involve thicknesses of hundreds of meters it is also difficult to account for these as due to alternating snow-fall and dust storm.

All that would be required by this proposal is that the wind flow rate, water content, and density be nonuniform on a vertical scale of hundreds of meters; a not at all unreasonable postulate.

The test would be to scratch away some of the surface in a region of such exposed bedding. If the striations are really due to the above described wind action then they should not persist very far into the side of the drift. A more immediate test would be that unconformities in the wind created pattern should be predominantly associated with bends in the side of the polar cap.

Unconformities and lenses were observed and photographed later in the winter. These were present in both the curves and planar sides of the drifts. The "curling" was confirmed but the cause, especially of the lenses, in the flat areas of the snowbank sides was not clear.

Reference

¹Cutts, J. A., K. R. Blasius, G. A. Briggs, M. H. Carr, R. Greeley, and H. Masursky 1976. North polar region of Mars: imaging results from Viking 2, *Science* 194(4271):1329-1337.

> Sincerely, Gerardus D. Bouw 43Kernwood Drive, Rochester, New York 14624. Received 11 January 1977

The Septuagint may not Provide Independent Evidence on Chronology

"All Scripture is given by inspiration of God, and is profitable . . ."; and "all" includes the genealogies and the "begat" sections.

Some students of Scripture, however, propose that there may be gaps in certain places, especially in the genealogies in the eleventh chapter of Genesis. I should urge, however, that people consider carefully whether to admit gaps is not to spoil the use of such parts for chronology, and to that extent to make Scripture unprofitable.

About five reasons have been proposed for suggesting gaps in the genealogies mentioned. It has been thought that more time was needed between the Flood and Abraham: (a) to fit in the centuries claimed in such chronologies as that of Egypt, (b) to make room for an ice age after the Flood, and (c) to allow the population to grow from Noah's family to the size which it must have had in Abraham's days.

It has been shown, however, in recent articles¹⁻³ that not one of these reasons proposed for extending the chronology by allowing gaps is really a compelling one. The fourth reason, sometimes suggested, is that the formula used in the genealogy in chapter eleven is slightly different from that in chapter five; and that this slightly simpler form may indicate less definiteness. However, it is much more likely that the different form indicates a different author. It is very likely that those sections of Genesis came to Moses as documents written by different patriarchs, and that Moses compiled them into Genesis.

The fifth reason given is that the chronology given in the Septuagint is considerably longer, especially in Genesis chapter eleven. I should like to comment on that point.

But "salvation is of the Jews", and "unto them were committed the oracles of God"; so it would seem that the Jewish text, the Masoretic, is the one which should be followed.

I suggest, moreover, that the extended chronology in the Septuagint is likely not independent of the long Egyptian chronology. So if the Egyptian chronology is not a convincing reason, neither is the Septuagint.

The Egyptian chronology, as it is commonly stated, depends much on Manetho, who wrote around 300 B. C. The Septuagint was prepared about the same time, or later. I suggest, then, that the translators who prepared the Septuagint were influenced by the inflated Egyptian chronology. They many not have consulted Manetho, but the notions incorporated in his work were no doubt widespread at the time.

So, just as there are those nowadays who would alter Scripture to fit in with science, these writers altered it to fit in with the chronology which they believed. It is noteworthy that most of the inflation comes in chapter eleven. For they may have thought that the time after the Flood was what had to be stretched, to fit in with the secular chronology; hence the writers did not meddle much with the earlier parts.

A small example of this same kind of thing has been suggested. In the Septuagint a dimension given for King Solomon's brazen sea is altered, possibly by a scribe who, knowing a little geometry, tried to correct what he thought was an error.⁴ But certainly the change is no improvement.

In conclusion, then, I should urge that contained in the chronology and genealogy of Genesis are data which give every evidence of careful transmission all the way from the source; and that such data should not lightly be set aside or altered.

References

¹Courville, Donovan A. 1975. Is a fixed chronology of Egypt back to c. 2000 B.C. mistaken?, *Creation Research Society Quarterly* 11(4): 202-210.

²Cox, Douglas E. 1976. Problems in the glacial theory. *Creation Research Society Quarterly* 13(1):25-34.

³Hanson, James N. 1977. An analysis of the post-Flood population growth, *Creation Research Society Quarterly* 14(1):62-70.

⁴Armstrong, H. L. 1976. King Solomon's brazen sea, *Bible-Science Newsletter* 14(11):5-8. (November).

Yours sincerely, P. H. van der Werff R. R. 4, Thamesford, Ontario, Canada Received 29 December 1976

CREATION RESEARCH SOCIETY

History The Creation Research Society was first organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a real need for an association devoted to research and publication in the field of scientific creationism, with a current membership of about 500 voting members. The Creation Research Society Quarterly has been gradually enlarged and improved and is now recognized as probably the outstanding publication in the field.

Activities The Society is solely a research and publication society. It does not hold meetings or engage in other promotional activities, and has no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund is maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible.

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2. All basic types of living things, including man, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.

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