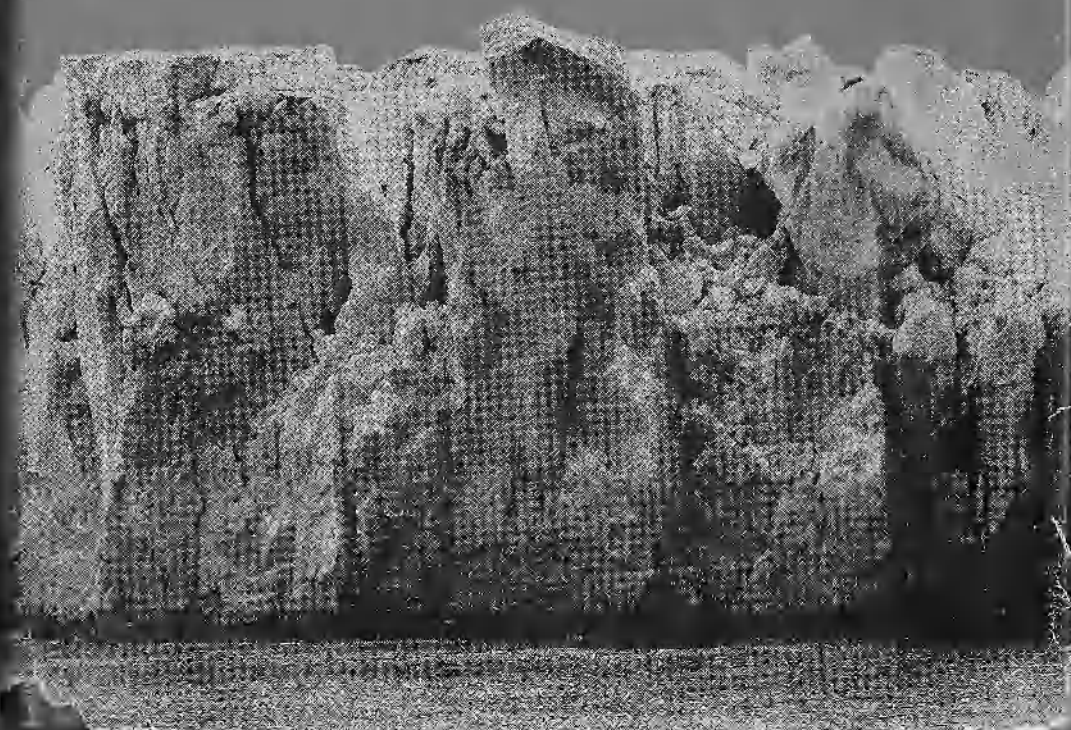


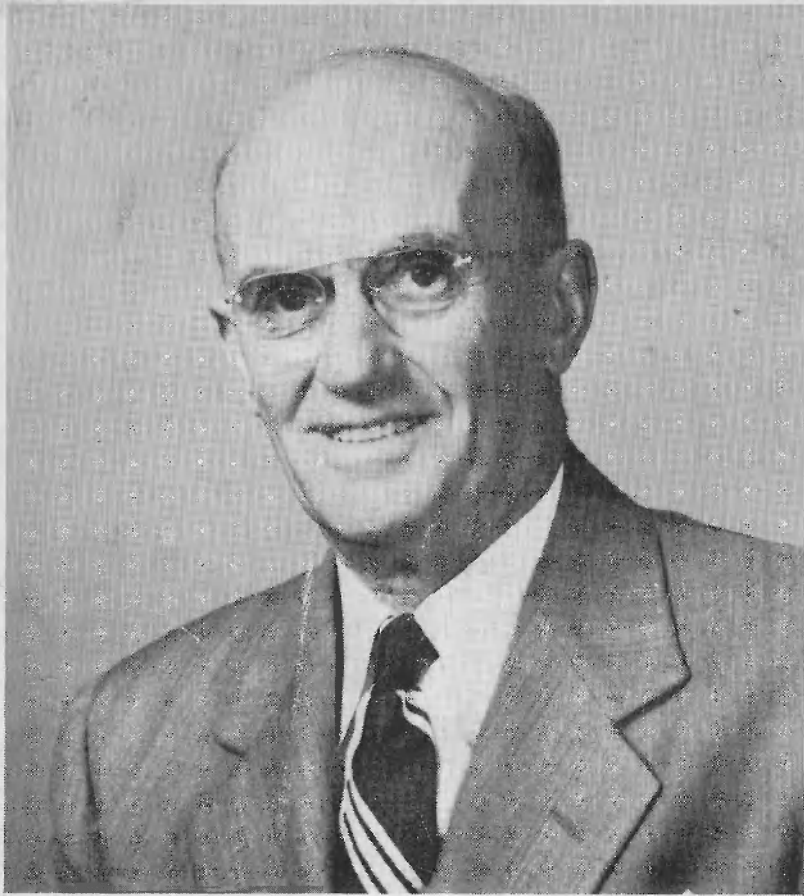
Those Astounding Ice Ages

AN EXPLORATION OF OUR PLANET'S MOST CHALLENGING MYSTERIES

by Dolph Earl Hooker

ILLUSTRATED





Meet the Author

THE AUTHOR of many articles on engineering and other technical subjects, Dolph Earl Hooker has long been a student of glaciers and once spent twenty-seven consecutive days and nights on glaciers of the Wrangell Mountains in Alaska.

He was born in 1883 in Carson, Iowa; was educated in architecture and structural engineering, and engaged in those fields until after World War I. From 1920 to 1945, he was a retail lumber dealer in Akron and Youngstown, Ohio. Now retired, he lives in the former city.

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Illustrated

Those Astounding Ice Ages

*An Exploration of Our Planet's
Most Challenging Mysteries*

by DOLPH EARL HOOKER

DOLPH EARL HOOKER'S consuming interest in the ice ages was generated almost half a century ago, when he was fascinated by huge glaciers while on a "gold stampede" in Alaska. It has continued unabated.

"The purpose of this book is to eliminate frustration of one hundred years' standing in attempts of scientists to solve glacial and other mysteries," the author states boldly, "—frustration due to complete vacuum of new concepts and blind adherence to old, refuted ones.

"The theory expounded in this book has gradually evolved over the ensuing years," Mr. Hooker continues. "As its concepts dawned, solutions of other great geological mysteries came to light," including the mystery of former lower ocean levels, and of the source of minerals in the earth's sedimentary crust.

Mr. Hooker's revolutionary theory about the mystery of the ice ages was inspired by visible conditions on other planets, particularly Jupiter and Saturn. These conditions, he says, pro-

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claim the amazing information that the earth's hydrosphere has been repeatedly augmented within geological time. One result was the glacial epochs.

"In spite of long continued efforts to prove that ice sheets accumulated because climate had deteriorated," he writes at another point, "there is evidence that glacial ice appeared with catastrophic suddenness. There is evidence that a time when temperate climatic conditions extended even into polar regions, the world, teeming with warmth-loving species of floral and animal life, was overwhelmed by fall of snow, ice and rain, so violent, so sudden, so chilling, that great numbers of creatures were forthwith destroyed." Some of these creatures "were destroyed and put into the deep freeze of Arctic glacial ice so suddenly that grass, branches and leaves of hard-wood trees they were eating at the moment did not have time to digest!"

The book is scholarly and designed to capture the interest and respect of scientists, yet written with such clarity that it readily can be understood by the layman. Abounding in fascinating geological lore, exploring theories about ancient physical phenomena, and presenting Mr. Hooker's challenging conclusions, *Those Astounding Ice Ages* is an important book on scientific and intellectual levels.

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*An Exploration of Our Planet's
Most Challenging Mysteries*

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DOLPH EARL HOOKER

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PREFACE

ASK ANY MAN why ice ages occurred and he will reply, "Why, obviously because the climate grew colder." He was taught that in school and college; furthermore, he frequently sees the same thought expressed even in the very latest scientific literature. Yet persistent study by eminent scientists of the mystery of glaciation—study continued for more than one hundred years—has failed to envision changes in terrestrial or celestial conditions which could have materially reduced climatic temperature. Moreover, all those years of study have failed to demonstrate that an ice age would or could have resulted even if the temperature had been reduced. It should, therefore, be evident at long last that some new approach to the problem must be taken if its solution is to be found.

My own interest in ice ages was generated nearly fifty years ago by intimate contact with huge glaciers while on a "gold stampede" in Alaska. My curiosity to discover the cause of ice ages was not satisfied, it was only whetted, by subsequent study of glaciers and of available literature on the subject.

The theory expounded in this book has gradually evolved over the ensuing years. As its concepts dawned, solutions of other great geological mysteries came to light—the mystery of former lower ocean levels, of the source of minerals in Earth's sedimentary supercrust. Admittedly, the theory is completely heterodox. Some factual statements, as well as some deductions and conclusions, may be erroneous. However, the basic concepts alone are important. Those concepts are strongly supported by logic, by physical laws and by visible terrestrial and celestial evidence. The theory is based upon principles directly opposed to all which have hitherto been advanced.

Inasmuch as all previous theories have utterly failed to solve the mysteries under consideration, this fresh theory should be welcomed. Let no one summarily reject it without studious consideration merely because it violates old teachings and threadbare theories which, as will be established, have been decisively refuted.

D.E.H.

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Great White Throne, Zion Canyon, from Scouts Lookout

Grand Canyon from north rim

Grand Canyon of the Colorado, showing horizontalism of rock strata

Successive seams of bituminous coal

Brooks Comet

To Robert Earl Hooker,
my son.

CHAPTER ONE

MYSTERIES OF GLACIATION

An Imaginary Aerial Tour

THE READER IS INVITED to accompany the author on an imaginary world-wide aerial tour for the purpose of observing phenomenal terrestrial conditions which existed very, very recently, as measured by the geological time clock. We will imagine we are living in the closing millenia of the Pleistocene epoch, perhaps only 25,000 or 30,000 years ago.

One warm summer day we take off from southern Texas in a northeasterly direction on our jet-propelled magic carpet. We have barely gained altitude when, upon reaching the area where the present Mississippi and Ohio rivers converge, we suddenly pass over the margin of a great expanse of solid blue ice which completely obscures hills, plains and lakes of the land beneath us. The ice is certainly at least hundreds and probably thousands of feet thick.

As we continue onward, our amazement grows as the immensity of the ice blanket becomes increasingly apparent. We continue northeasterly over New York State, New England, Nova Scotia, Newfoundland and the Grand Banks, without finding a single break in continuity of the ice sheet. We swing northward over Davis Strait and Greenland, westward over Hudson Bay and Canada to the Pacific Coast, thence north over upper Canada and the Arctic Ocean. After passing over the North Pole and continuing south into Northern Russia, we swing westward and pass over the Scandinavian Peninsula, the Baltic Sea and the British Isles.

We have seen no uncovered land whatsoever, except a tiny patch in southern Wisconsin, some areas in Alaska and Siberia.

plus here and there a mountain peak protruding above the surface of the ice. Davis Strait, Hudson Bay, the Great Lakes of North America, all the islands off the northern borders of North America, the Baltic and North seas and shoal portions of the North Atlantic and the Arctic Ocean are all unbroken fields of ice. Not a bird, not a beast, not a tree or plant of any kind lives anywhere throughout this unbelievably vast expanse of horribly desolate, deadly silent, bitterly cold ice.

Deciding to continue our explorations, we find areas similarly covered with ice in Europe, Asia, China, even India; also in South America and Africa. There is some ice in Australia, New Zealand and Tasmania. A somewhat enlarged Antarctica is completely ice-covered.

Thus our imaginary tour disclosed a very considerable percentage of Earth's land surface in both hemispheres buried under immense, deep blankets of solid ice. In North America the ice extended south to latitude 40; in India and Africa to even lower latitudes. Amazingly, even at mid-temperate latitudes the ice covered some areas only a few hundred feet above sea level! All continental platforms were just like they are today except that they were somewhat larger. A great many land areas, now separated by oceanic waters, were then joined. The Chukchi Peninsula of Siberia was connected with the Seward Peninsula of Alaska. The China and Japan seas were dry land. The island chain from Asia to Australia was so much enlarged that the two continents were virtually connected. The British Isles were connected to the European continent. The Baltic and North seas were ice-covered dry land. In all the oceans there were islands and ridges which are now submerged.

We noted large inland lakes in continental basins which are now arid. Between the Rockies and the Sierras of North America a vast lake existed. Large areas of the Russian steppes were under water. A much larger Caspian Sea embraced the Aral Sea. A huge lake existed in the Sahara of Northern Africa. The Black Sea was separated from and much higher than the Mediterranean. The waters of the latter were a hundred fathoms below their present level. Roaring streams, cutting deep furrows

into her mountainous shores, were pouring their waters into her basin. An isthmus at Gibraltar joined Europe and Africa.

All oceans were noticeably smaller and shallower than at present. However, it was obvious that they were destined to increase considerably in breadth and depth within a few hundred years because of the tremendous amount of water pouring into them from the melting ice sheets. We saw many signs that terrific floods, caused by tremendous rainfalls, must have recently occurred in areas throughout the world which were not ice-covered.

Solar conditions, lunar and terrestrial relations and motions, axial inclination of the Earth and eccentricity of her orbit appeared to be the same then as they are now. Only a moderate difference in climate was discernible, apparently due solely to the chilling effect of the enormous ice sheets. Rain storms in torrid and temperate latitudes and snows in colder regions were occurring much as they do today. It was apparent that within a few thousand years all the ice would be melted away, except in polar regions and on mountain peaks.

Raging rivers flowing from melting ice fields were making their way to the oceans, down valleys and canyons which the turbulent waters were rapidly eroding. These rivers obviously were adding enormous loads of silt, sand and gravel to ocean floors along continental borders. In other places violent streams were racing down inland mountain slopes, accomplishing erosions and depositing sedimentary strata in inland basins on a greatly magnified scale compared to today.

The foregoing description of conditions which existed on Earth during what geologists call a very recent period, cannot be greatly in error, according to current scientific belief, based upon evidence and careful study by leaders in the field.

Glaciations Occurred Repeatedly

The glaciation we observed took place during the Pleistocene period, which began about one million years ago. There were four fluctuations of increase and decrease of the ice during that epoch as shown by clearly disclosed advances and retreats of the terminal moraines of the ice sheets. It is more or less customary for writers to refer to the Pleistocene period, or epoch, as "The Ice Age," thereby giving the impression that it was the only geological period in which glaciation occurred.

However, other glaciations, similar to the one we observed on our imaginary excursion, but varying in severity, are known to have occurred time and again at irregular intervals, separated by millions of years. Eleven glacial episodes have been identified with the following periods, beginning with the most ancient: Keewatin, Timiskamian, Huronian, Animikean, Keweenawan-Cambrian, Ordovician, Silurian-Devonian, Carboniferous-Permian, Triassic-Jurassic, Eocene, Pleistocene. Naturally, evidence of the extent and effects of the more ancient ones has been largely obliterated by subsequent erosion and tectonic disturbances.

C. E. P. Brooks, the eminent British geologist, writing in *Climate Through the Ages* (1949 revised edition) says:

There have been at least four major ice ages: in the early Proterozoic, in the late Proterozoic, or Algonkian, in the upper Carboniferous, and in the Pleistocene-Recent period. Of the first two we know little; but that little suggests that they were entirely analogous to the Quaternary. The upper Carboniferous glaciation, on the other hand, was highly abnormal, in that the greatest ice sheets developed in regions which are now not far from the equator.

John Wolbach of Harvard University (paper #6, Shapley's *Climatic Change*) expresses substantial agreement with Brooks when he writes that, according to geological evidence, ice sheets in the Pleistocene and Huronian episodes formed most exten-

sively in high and temperate latitudes, while Permian glaciation developed principally in the tropics. He says that the Cambrian or late Proterozoic ice sheets developed not only in temperate zones of North America and Europe, but also in tropical South Africa, in India and in China. He concludes that

the Permian glaciation began in Carboniferous times, with small ice sheets in Australia and South America. In the Permian period, extensive glaciers developed throughout the tropics and south temperate zones. In Africa ample evidence points to glaciers as extensive as those of North America in the Pleistocene. . . . Extensive glaciations also took place in Central India and in regions to the south now submerged by the Indian Ocean.

Glaciation in the Southern Hemisphere

When study of ice ages first began, less consideration was given to glaciation in the southern hemisphere. Earlier writers apparently failed to realize that glaciation was contemporaneous in both hemispheres. That such is true is now generally conceded. R. F. Flint, in his *Glacial Geology and the Pleistocene Epoch* (p. 453) expresses this view when he says: "the weight of evidence is strongly suggestive that the glacial ages were synchronous throughout the world." Maurice Gignoux, in *Stratigraphic Geology* (p. 245), referring to Carboniferous glaciation in the southern hemisphere, says:

The Carboniferous ends with a great glacial development, not confined to mountain valleys, but extending over immense spaces and thus comparable to the Quaternary ice caps of the northern hemisphere.

Evidence indicates that the present ice sheet on the continent of Antarctica was deposited during the Pleistocene, therefore, contemporaneously with deposition of Pleistocene ice sheets in the northern hemisphere.

Many writers, both early and recent, create the impression that glaciation in the southern hemisphere was much less pronounced than in the northern. Evidently, they fail to take into

consideration the relative proportions of land and sea in the two hemispheres. In the northern hemisphere the Pleistocene ice sheets in North America and Eurasia extended south to the 50th parallel or even farther, yet probably not more than about 80 percent of all land north of the 50th parallel in the eastern and western hemispheres combined was ice-covered. In the southern hemisphere however, it seems indisputable that literally 100 percent of all land south of the 50th parallel was ice-covered. More than 95 percent of such land today is still completely blanketed with ice! Also there is unmistakable evidence that the glacial blanket of Antarctica in the past was far thicker than it is now. Hence it certainly is incorrect to believe that glaciation in the southern hemisphere, during the Pleistocene at least, was less severe than it was in the northern hemisphere. Furthermore, no evidence has been discovered to date that Antarctica escaped glaciation during earlier ages when the northern hemisphere was visited by ice sheets.

Enigmas

During more than one hundred years, since 1837, when Louis Agassiz, the famous Swiss naturalist, first made it generally known that the world has experienced glacial episodes, countless scientists have sought in vain to account for the amazing phenomena. In efforts to solve the mystery, many inexplicable enigmas and contradictions are encountered, including the following:

(a) There was no semblance of uniform periodicity in the succession of the episodes

(b) The deposits of ice were localized with little regard to altitude or latitude. They occurred at sea level or at altitudes of only a few hundred feet within 40 degrees or less from the equator. They occurred even within the tropics in some places

(c) They occurred contemporaneously in both the northern and southern hemispheres

(d) It has always been assumed that glaciation eventuated because terrestrial climate grew colder; yet it is the consensus of

paleontologists that warm, temperate climates have been the rule throughout geological time, that glacial climates were exceptions to the rule, were of comparatively short duration and were quickly followed again by mild climatic conditions. Decisive evidence that climate degenerated prior to glacier formation has not been discovered

(e) It has likewise always been assumed that the ice sheets accumulated slowly after climate had gradually deteriorated; yet there is definite evidence that the ice appeared with catastrophic suddenness, substituting frigid climatic conditions and inflicting wholesale destruction upon temperate-type fauna and flora existing under benign conditions even within both polar circles and at the very time the ice appeared.

In any attempt to fathom the mystery of ice ages, it should be borne in mind that all glacial periods, certainly from the Cambrian up through the Pleistocene, occurred long after Earth's crust had formed and cooled and after conditions on Earth had become substantially the same as they are today. Surface configuration, continents and ocean basins were essentially the same then as they are now. Obviously, climatic conditions, air and water to sustain life were very similar. This is definitely proved by the plant and animal life we know existed at the respective periods. The regular, the normal, the ordinary condition throughout the greater part of geological time has been one of mild and comparatively uniform climate extending to and even within both polar circles.

Basic Premises of Theories

Many theories have been advanced to account for glacial episodes. Volumes would be necessary to explain the theories in detail. Suffice it to merely mention their basic factors which, according to the various hypotheses, caused ice ages to eventuate:

- (1) Elevation of land areas to higher altitudes above sea level
- (2) Changes in relative proportions of land and sea areas
- (3) Changes in locations of land areas by the floating of continents on a fluid terrestrial interior

- (4) Changes in locations of the poles
- (5) Increase of obliquity of Earth's axis
- (6) Increased eccentricity of Earth's orbit
- (7) Passage of the solar system through colder or nebulous regions of space
- (8) Decrease in the amount of solar heat radiated
- (9) Changes in air and ocean currents caused by topographic alterations
- (10) Amount of carbon dioxide, volcanic and cosmic dust in the atmosphere
- (11) Decrease of internal terrestrial heat

Fate of Theories

Now what has been the fate of these various theories? Every one has been analyzed and thoroughly studied by leading scientists throughout the world; and every single one has been rejected as untenable. The truth of this statement cannot be successfully challenged. Admittedly, the author of any particular theory refuses to reject his own, although in some instances he does admit that it is open to doubt. However, for each proponent of any hypothesis there are dozen critics who find flaws and reject it. The consensus unquestionably is that not one of the theories constitutes an acceptable solution of the mystery.

Perhaps the verdict of Mr. W. B. Wright can be taken as typical. Nobody will question that Mr. Wright is one of the more distinguished students of the subject. His exhaustive, erudite book, *The Quaternary Ice Age*, embraces 464 pages. On page 463, next to the last, he summarizes his studies with this conclusion:

It must be admitted that among the theories which have been brought forward to account for the phenomena of the Ice Ages, there is not a single one which meets the facts of the case in such a manner as to inspire confidence.

Another distinguished scientist, Dr. A. P. Coleman, in closing his exhaustive study, *Ice Ages, Recent and Ancient*, laments:

It may be expected that the present writer, after pointing out defects in all the previous attempts to solve the tangled problems of glacial periods, should propose something which he considers more satisfactory. This I do not feel competent to undertake. During many years of study of glaciations I have hoped to find a solution of the difficulties in several theories at different times but have always encountered some point where they failed.

Other geologists also have reached the conclusion that the mystery remains unsolved. For instance, John H. Bradley, Jr., in *The Earth and Its History*, says: "Although many explanations have been offered, no universally acceptable hypothesis for the causes of glaciation has yet been produced."

A Recent Theory

The criticism may be made that the above opinions are old and out of date; yet the fact is that every theory in existence today had been previously expounded and was studied by the above critics before their conclusions were reached. Many recent investigators have arrived at the same conclusions which have been cited. The inference that no new theory has lately been advanced may be challenged by citing the recent one propounded by Richard Foster Flint. He first rejects separately every other theory listed herein before; then advances one of his own, which he calls the "Solar-Topographic Hypothesis" (p. 512). It has two essential elements, namely, "fluctuation of solar radiation" and "presence of highlands" as the prime factors determining the accumulation of snow. It can readily be seen that his hypothesis is merely a combination of the old theories numbered (1) and (8), listed above; and as stated before, he had previously discounted both separately. Mr. Flint admits that there is nothing new in his theory, and he can, by his own words, scarcely be considered very enthusiastic about it. He says that

the evidence in support of the first part (fluctuation of solar radiation) is limited to the fact of short-term fluctuation through

a small range, beyond which, fluctuations have to be *assumed*. (Italics added.)

As to the second part (topographical uplifts) he says:

Only when uplifts were unusually high and widely distributed, especially in the regions traversed by the belts of westerly winds, could extra-terrestrial heat fluctuations succeed in reducing temperatures enough to bring about the building of great glaciers.

He fails to establish that "unusually high" uplifts have ever occurred sufficiently "widely distributed" to have caused the known world-wide distribution and recurrence of ice sheets. Neither does he offer evidence to sustain the assumption that long-term, wide-range fluctuation of solar heat radiation has occurred. He says that "all we can say at present is that larger fluctuation is at least possible." A theory whose merits depend so largely upon mere assumptions would seem to fall short of conclusiveness.

In his later book, *Glacial and Pleistocene Geology*, Mr. Flint says of his hypothesis (p. 503):

Whether it will stand up under analysis . . . remains to be seen. At best it is only a very general framework. Undoubtedly the true explanation of the Pleistocene climatic changes is much more complex than the concept as stated.

It is generally conceded that as late as the closing centuries of the Pleistocene period continental land platforms were essentially the same as they are now. The question is, can the solar-topographic theory explain how, not more than a very few thousand years ago, an unbroken ice sheet hundreds or thousands of feet thick could accumulate to cover an area 1,500 miles wide, extending south to within forty degrees of the equator—a flat plains region with an average altitude above sea level of less than 1,000 feet; a region centering 1,500 miles from ocean waters; an area where average summer temperatures reach well up toward the nineties. Such an ice sheet existed in what is now the north central United States and perhaps not

more than 25,000 years ago. It cannot be doubted that topography of the area at such a recent time was essentially identical with that of today. It seems probable that the solar-topographic hypothesis may in time meet the same fate as have all the other theories.

Although many similar statements are found in current treatises, one more quotation should suffice to convince the reader that all theories of ice-age origin have been rejected. This final quotation is taken from *Geology, Principles and Processes*, 1955, by Emmons, Thiel, Stauffer and Allison, who say: "Many hypotheses have been offered to account for the climate which resulted in continental glaciation, but none is generally accepted."

A Fresh Theory Overdue

Thus it is plain that all theories advanced in more than one hundred years have been adjudged unacceptable by the world's most eminent scientists. For that reason the fresh theory which will be presented later herein, although it may be labelled rank heresy by persons too bigoted to entertain a new idea, should be welcomed and received with open minds by all who earnestly seek scientific progress.

The theory will disclose that conditions which made it possible for ice ages to occur have passed away forever and that another glacial episode cannot possibly occur if and because climate should grow colder or for any other reason. The theory will be based upon principles diametrically opposed to all which have been repudiated. It will be supported by logic, by physical laws of nature and by visible evidence which cannot be refuted. Its basic premises will instantly illuminate a host of hitherto obscure geological puzzles. There is scarcely a single phase of the mystery of glacial phenomena which the theory will fail to explain. It alone of all theories will disclose *in combination* both a source adequate and a force competent to supply the incredibly vast amount of water which was frozen in the continental ice sheets.

The theory will account for lack of periodicity in succession of glacial episodes. It will disclose why and how it was possible for mild climatic conditions, comparatively free from latitudinal variations, to extend almost from pole to pole. It will explain why, in spite of such mildness of climate, great ice sheets could nevertheless be formed even at low altitudes and low latitudes. It will account for erratic, regional distribution of the ice. It will show why it was possible for ice sheets to form contemporaneously in both hemispheres. It will account for the sudden arrival of the ice—so sudden that many species of teeming animal life over great areas of the globe were utterly destroyed. It will explain why glacial periods were of short duration. It will tell us why all such periods, with the exception of the last one, were quickly followed by warm climatic conditions, extending from pole to pole. The theory will be based not upon mere imagination but upon visible planetary evidence and accepted natural laws of motion and gravitation. But first let us analyze the basic concepts of old theories and expose defects which make them untenable.

Old Theories Embrace Three Assumptions

An analysis of all theories which have heretofore been advanced shows unmistakably that without exception every one is based upon the preconceived assumption that colder climate, *per se*, was the cause of ice ages. Actually, therefore, not one theory can be considered to be a quest for the cause of glaciation. The cause has just been assumed to be colder climate. The one and only aim of every theory has been to conjure up solar, astronomical or terrestrial differences from present conditions which would cause reduced climatic temperature. Page after page of any book devoted to glacial epochs contain statements and allusions which plainly show that the author is not seeking the cause of ice ages—he is obsessed with the preconceived conviction that the cause was colder climate and is seeking only to discover what could have caused the colder climate.

This concept has persisted since 1837, when Agassiz first

showed that the world has experienced glacial episodes. It still persists. Every bit of literature on the subject, both old and new, is colored and dominated by that presumption. Even in the latest scientific literature we read that should climate turn colder by a few degrees another ice age would result. In *Geology* (1952), von Engel and Caster make the statement that "a lowering of the average annual temperature of the Earth by 10 to 15 degrees F. would suffice to initiate another glacial epoch." Emmons, Thiel, Stauffer and Allison, in describing current temperature conditions in the White Mountain region of New Hampshire say: "A drop of only a few degrees in the average annual temperature . . . might restore continental glaciation over a vast area." V. Ben Meen, writing about Chubb Crater in the *National Geographic* of January, 1952, says: ". . . any prolonged drop in temperatures would bring back the Ice Age." Similar statements by many others could be quoted.

Surface Water Assumed as Source

A second assumption which has been universally, invariably and persistently followed is that the moisture in glacial ice came from evaporation of Earth's surface waters. No other source has been suggested. Apparently none has been imagined. As we shall see later, the concept cannot be logically sustained.

A third notion, which naturally flows from the first two, and which also colors, permeates and dominates all literature on the subject, is that ice sheets developed slowly, from left-over remnants of ordinary winter snowfalls. One writer (R. A. Daly in *The Changing World of the Ice Ages*) states that "the ice caps grew in bulk for tens of millenia." Others speak of the "gradual growth" of the ice sheets; of ice sheets "gradually encroaching" over areas, "advancing," "creeping outwardly from centers"; of many separate mountain-valley glaciers spreading sidewise until they "coalesced" into vast continental ice sheets, etc.

Cold Reduces Evaporation

Taking up first the concept of colder climate as the cause, let us inquire where the ice in any ice age came from. Nobody has ever been able to imagine a source other than the sky above. Nobody can doubt that the moisture which formed the ice could have come only from aloft, either as rain, snow or ice, from aqueous vapor, frozen or otherwise, which had been put up there by some agency. That such must have been the case is self-evident and indisputable. As stated before, it is the unanimous belief of all theorists that this water came from evaporation of ocean and other Earth-surface water.

Now we inquire what agency is it that evaporates water. There is only one answer, namely, heat. Heat of course is a comparative term. Greater heat augments evaporation. Lesser heat decreases it. The less the heat, the less the evaporation. In other words, the lower the temperature, the less the evaporation. Hence if, as is commonly thought, glaciers were built out of evaporated surface water, how could decrease in climatic temperature possibly favor their growth? Certainly copious evaporation, rather than meager, must have been a prerequisite for their growth. Formation of snow necessitates prior "work." To lower the fires would be to decrease the energy required to form and raise water vapor to the skies. Both heat, not cold, and copious, not meager, evaporation would be necessary to build vast continental ice sheets if the ice were to come from evaporated surface waters. It is just that simple; and attempts to refute it are futile.

Efforts to sustain the theory that colder climate would cause an ice age have produced astonishingly illogical concepts. For instance, it has been stated that if ocean waters were to grow colder a glacial age would result. Surely it is evident that the only agency which could cause ocean waters to grow colder is lower climatic temperature. It is equally evident that colder climate would lessen evaporation and consequently would de-

crease precipitation; hence would retard rather than foster glaciation.

Pluvial Lakes

A mystery which has puzzled those who believe that glaciation was caused by colder climate is that many interior basins in presently arid regions have been repeatedly filled with water in the past. It is the concensus that such "pluvial" lakes were concomitant with ice sheets; that "inter-pluvial" intervals were synchronous with "inter-glacial" intervals; and that the concurrences applied during all glacial and non-glacial cycles. To account for this, T. F. Jamieson, according to Flint, wrote:

Now this heat and dryness (of the arid regions) being much lessened during the glacial period, there must have resulted a much smaller evaporation, which would no longer balance the inflow. These lakes would therefore swell and rise in level.

Thus, while admitting that lower temperature would decrease evaporation, inferentially and quite inconsistently he asserted that precipitation and consequent inflow would not thereby be lessened.

Surely it is manifest that if evaporation of inland lake waters were lessened by colder climate, evaporation of ocean waters would be correspondingly lessened. Hence precipitation and inflow to inland lakes would be proportionately decreased. It follows too that precipitation of snow in colder regions would likewise be reduced and growth of glacial ice would be rendered less likely.

R. F. Flint, in *Glacial and Pleistocene Geology*, borrows the above ideas of Jamieson when he says (p. 224):

The immediate causes of expansion of lakes in dry regions of middle and low latitudes appear to have been increased precipitation and decreased evaporation, which characterized the climates of glacial ages in those regions.

Does he insinuate that "increased precipitation and decreased evaporation" applied only to "dry regions of middle and low latitudes"? As has been pointed out by numerous geologists, the evidence is that swelling and shrinking of pluvial lakes occurred synchronously with the waxing and waning of the ice sheets. It would seem, therefore, that if climate had anything to do with those phenomena, that whatever characterized the climate of middle and low latitudes must also have characterized the climate of high latitudes. Hence it would have to be assumed that increased precipitation, coupled with decreased evaporation of ocean waters, caused the ice sheets to accumulate!

That increased precipitation could occur synchronously with decreased evaporation is so illogical that it seems incredible the idea could be seriously entertained. To illustrate: At the present time exactly the same amount of water which is being evaporated from day to day is being condensed and precipitated back to Earth. If, then, the amount of water being evaporated were decreased, how could the amount being precipitated possibly be increased! The idea is self-evidently preposterous.

Cold Climate Theory Futile

The foregoing examples illustrate some of the contradictions inherent in the concept that colder climate was responsible for glacial and related phenomena. Formation of vast continental blankets of ice, aggregating millions of square miles in area and hundreds—even thousands—of feet deep, in concert with and because of refrigerated climate, is fundamentally antithetical, contrary to physical law and completely illogical. Efforts by hundreds of scientists to validate the concept, continued for more than one hundred years, have failed utterly. Should such efforts continue for another hundred years, the result would remain the same. Surely the only reason the concept persists is that no other cause of glaciation has been conceived.

However, for the sake of argument, let us assume the proponents of the cold-climate theory may be correct and that re-

frigeration of climate did in fact cause glaciation. Let us see to what destination the theory leads us. First we wonder just how cold, in all conscience, does climate have to become before accumulation of ice commences. At the present time, there are several regions on Earth where mean temperatures are mighty low, undoubtedly much lower than fossil evidence definitely proves was the case at the time the glaciers put in their appearance. Not only in the northern portions of Europe, Asia and North America, but even within both polar circles, as we shall see, preglacial fossils prove that mild climatic conditions existed at the very time the ice arrived.

Antarctic Ice Is Shrinking

Antarctica is without doubt the coldest region on Earth today, with the interior of Greenland a close second; yet even in those frigid areas no increase whatsoever of ice is presently taking place. On the contrary, the ice is slowly diminishing. All explorers agree that this is a fact. For instance Lawrence McKinley Gould, geologist and second in command of the Byrd Antarctic Expedition of 1929, in his book *Cold* says:

. . . we found evidence that the ice cover on the plateau [of Antarctica] must at a former time have been much thicker than now; and previous students have found widespread evidence that in former times the continental ice cap in all its ramifications must have been much more extensive than now. It is quite right to think of the present ice cap as a relic of a much greater ice mass which existed here when other parts of the world were also in the grip of the so-called Great Ice Age.

Thomas R. Henry, a member of Byrd's expedition of 1946-47, in his book *The White Continent* writes:

Within the past few million years the continental ice sheet has been much thicker and flowed over the tops of mountains in the rim of the bowl. . . . Perhaps fewer than a million years ago the frozen ocean which now covers the interior of the continent was hundreds of feet deeper than at present.

As a matter of fact, the lower the temperature, the less is the snowfall. Heavy snowfalls occur only in comparatively mild, not excessively cold weather, and heavy snowfalls in the north and south polar regions are a myth. The reports of Scott, Shackleton, Peary and others who have been there agree that there is very little snowfall, in fact practically none, in the interior of Antarctica, Greenland, or on the sea ice in the Arctic Ocean. Even sled tracks of former expeditions have remained visible to subsequent explorers years later. Peary writes that "the ceaseless winds blowing from the interior outward toward the periphery of the Greenland ice cap prevent increase in the height of the ice." The interior of Antarctica is an ice-covered continent quite beyond the reach of heavy snowfalls resulting from condensation of water vapor formed in warmer zones. Such vapors fall long before they reach the interior of Antarctica or exist as impenetrable, constant fogs in latitudes much farther north. Relative to precipitation in the interior of the continent, Henry writes:

The everlasting wind blowing from the pole is as dry as the winds over the Sahara. . . . This lack of precipitation is the chief factor operating to bring the Antarctic ice age to an end.

He says the ice cap

is constantly flowing outward through the mountain gaps. . . . If this movement should continue for a few more hundred thousand years the ice cap may almost entirely disappear.

Flint says (pp. 49-50) that precipitation at Little America Station at the outer edge of the Ross Shelf is equivalent to only $7\frac{1}{2}$ inches of rain; and on most parts of Antarctica it is probably less than 5 inches.

Proponents of the refrigeration hypothesis may discount as immaterial the fact that mountain glaciers in Alaska, in Pacific Coast ranges, in Glacier National Park, in the Alps, in Scandinavia, in South America—in fact, all over the globe—are presently shrinking, as they positively are; but when we know that the great continental ice sheet is also steadily diminishing in

Antarctica, the coldest area on Earth, where temperature never rises above freezing, how can anyone possibly continue to believe that a still colder climate would cause glaciers to accumulate and institute another glacial age? It surely is evident that increased precipitation of snow would be necessary to augment Antarctica's present ice sheet. If this ice blanket is not increasing today in that frigid climate, does it not clearly follow that cold climate did not cause the ice to accumulate in the first place?

It seems strange that learned scientists would so long cling to the hypothesis that colder climate could have been the cause of ice ages. As said previously, the only possible explanation must be that they have failed to envision any other cause.

Doubt in Theory Is Growing

In earlier years of glacial study doubts were expressed only very rarely, and then quite timidly, that perhaps colder climate would disfavor rather than stimulate glaciation. Recently, more and more scientists are inclining to this latter view. For instance, Dr. Donald H. Menzel of Harvard, in his paper on *The Causes of Ice Ages*, read in 1952 at a conference sponsored by the Rumford Committee of the American Academy of Arts and Sciences, as quoted in Howard Shapley's *Climatic Change*, said:

I have always believed that an ice age is not, of necessity, a cold age. . . . In fact, as others have noted, an increase of solar radiation, rather than a decrease, may well bring about an ice age, because of the greater evaporation from the oceans produced by the stronger solar radiation. . . . As I see it, we need both greater precipitation and greater cloudiness—two primary agencies necessary to ice formation.

Dr. Barbara Bell, in her paper *Solar Variation*, given at the same conference, writes:

Let us now consider what solar variation needs to be postulated to explain best the observed periods of extensive glaciation. The more obvious hypothesis states that the ice ages result from a

decrease in the solar radiation, with a consequent lowering of Earth's temperature. But Sir George Simpson has severely criticised this hypothesis. He points out that the principal consequence of such cooling would be a great decline in the moisture content of the atmosphere, in precipitation and in general vigor of atmospheric circulation.

Dr. Bell goes on to say that due to such reduced precipitation it would be "virtually impossible to build up any appreciable ice sheet on the land." She adds that no satisfactory answer to Simpson's criticism has been produced.

Other similar opinions have lately been expressed. Thus it is evident that suspicions are finally developing that the colder-climate hypothesis is not tenable. But instead of aiding in the quest for a solution of glacial mysteries, these growing suspicions can only magnify the problem, unless and until some alternate cause of ice ages is presented to take the place of the doubtful supposition that cold climate was the cause and surface waters the source of the ice. Such an alternate cause will be disclosed in pages to follow.

Did Oceans Supply Moisture?

Considering next the idea that glacial ice came from evaporated surface water, let us try to estimate how much water would have to be evaporated to fill the order. It has been estimated that the ice still remaining on Earth would, if all melted, raise the ocean level by nearly 200 feet. Certainly, the maximum amount of ice contained, say in the Pleistocene Ice Age, was several times greater than the volume still remaining. It seems reasonable to believe that oceans would have had to be lowered at least many hundreds of feet, to produce the indicated quantity of ice in any of the major ice ages.

It surely would be true, if glaciers came from evaporated ocean water, that while the millions of cubic miles of snow or ice were falling to build the prodigious ice sheets, other millions of cubic miles of water must have been falling as rain simultaneously on other portions of Earth's surface. It seems

inconceivable that all the water vapor was carried by air currents only to those certain areas where ice caps were forming and that none of it was carried to other areas where it would fall as rain.

Not one whit more water vapor is being formed now, from day to day, than is condensing and returning to the ocean. Hence it seems impossible to escape the conclusion that evaporation would have had to be more copious when ice caps were accumulating than it is now. How much more copious, depends of course on how long it took the glaciers to mature.

Evaporation Required Per Year

From what we have noted regarding the natural law which controls evaporation, we know that if evaporation were more copious than it is now, climate must necessarily have been warmer—not colder. The question is, how much warmer. If the glaciers were formed say in 20 years, and if they consumed ocean water to a total depth of 1,000 feet, the average consumption per year would have been 50 feet. If it took 20,000 years for the glaciers to form, the average consumption per year would have been a mere one-twentieth of one foot. These figures are exclusive of the amount of water which, as we have reasoned, must have been falling simultaneously as rain on areas where ice was not forming. As the total area of present land known to have been covered by ice was about one-third, and as the present land covers only about one-fourth of Earth's surface, there was eleven times as much global surface not covered with ice as there was glaciated. So, on a percentage basis, we would be justified in multiplying the estimated annual evaporation figures given above by eleven; but in deference to any claim which might be made that a major portion of the water vapor perhaps was steered in the direction of the glacial areas, let us multiply by eight instead of eleven.

Boiling Oceans

If, then, we choose to assume that the glaciers consumed a total of 1,000 feet of water and were formed in twenty years, 400 feet of ocean depth must have been evaporated per year. To evaporate at an average rate of more than one foot per day, winter and summer, throughout tropical, temperate and frigid zones alike, the oceans would literally have to boil! Can anybody believe that an intensity of solar or terrestrial heat sufficient to make the oceans boil would fail to kill every living thing on Earth? Yet we know that both living creatures and thriving florae very closely akin to present species existed in abundance when the ice arrived.

Furthermore, it is incredible that snow and ice could survive and accumulate in heat sufficient to boil the oceans. Yet the concept demands that one-eighth of all the water evaporated by such intense heat would condense into snow, which, after falling, would survive the heat and accumulate without loss for twenty years! Of course this concept is just too preposterous to be considered.

Slow Growth Assumed

Hence we are forced to resort to the other alternative, namely, that the glaciers formed very slowly, over periods of thousands of years. This is the conception of all theorists; and adherence to the notion is precisely the basic cause of the difficulties in which they find themselves. They know that water vapor from meager evaporation could not remain aloft until the total amount involved in an ice age could accumulate, because frequent rains and snows would prevent it. On the other hand, they just cannot figure out why little annual increments of falling winter snow would refuse to melt in the heat of summers, particularly at low altitudes and in temperate or subtropical zones, but would continue to pile up for thousands of years. In an attempt to escape the horns of the dilemma they conclude

that climate just necessarily must have been considerably colder at the time! So they invent the theories which have been listed, in a vain attempt to justify the conclusion. Yet, as we have reasoned, even if refrigeration of climate had occurred, as the theories attempt to prove, the lower temperatures would have lessened, not promoted glaciation.

Some theorists, however, suggest that the snow itself, after sufficient accumulation, even at low altitude and latitude, would set up an "anticyclonic engine" of its own to permit accumulation. Presumably, therefore, after the first hundred years or so of accumulation, there would be no problem. What would prevent melting during the first hundred summers is not stated.

Fantastic Explanations

The assumption that ice sheets accumulated from surviving remnants of ordinary winter snowfalls obviously goes hand in hand with the third assumption, namely, that the glaciers developed slowly. This dual concept has been held since the time of Agassiz and today is still held unanimously by all students of glacial mysteries.

In efforts to overcome the paradoxes inherent in this dual concept, some fantastic and incredible explanations have been suggested. Outstanding among the riddles is the big mystery, already mentioned, of how could small, annual increments of ordinary winter snowfall in temperate and tropical regions possibly manage to survive the heat of following summers for thousands of years while the snow was accumulating and compressing into ice. Ice sheets developed in tropical India, Africa and South America. In central North America, Pleistocene ice fields extended south to the 40th parallel. To explain the latter incident it is suggested that the ice might have formed some 1,500 miles farther north, on highlands assumed to have then existed and "crept" from those "centers" of origin south to the above latitude. If that explanation fails to satisfy, the alternate explanation is: "Well, climate just must have been a lot colder at the time."

Displacement of the Poles

To account for the fact that ice sheets, more especially during the Permian epoch, actually formed in the tropics, the explanation has been soberly advanced that the locations of Earth's poles must have been different, so that regions now in the tropics were then much nearer the poles! No reason whatsoever has been produced to show that the poles could ever have moved far enough to be placed where the tropics are now, much less to show that such a change could have occurred as recently as the Permian epoch. Furthermore, even if the poles in Permian time were situated in present tropical regions, the fact would not account for ice which also accumulated at that time in other areas which under that hypothesis were then temperate. Likewise, in the Pleistocene and other glaciations, ice sheets, in addition to forming in upper latitudes, also accumulated, though less extensively, in or near the tropics. In other words, glaciations were more or less world-wide. Hence the theory of transplanted poles, even if it could be validated, would be completely impotent to offer a solution. The whole idea is purely imaginary and approaches the preposterous.

Highland Centers

The assumption that ice sheets originated upon and advanced from "centers" of high altitude appears to be of doubtful validity. The concept comes from observation of existing mountain-valley glaciers. There is a quite unjustified habit of classing and comparing glaciers which form on mountain heights and flow down the valleys with continental ice sheets, which in bygone ages spread unbroken blankets of ice over vast areas of comparatively level land of low altitude and low latitude.

There is no mystery whatsoever about how mountain glaciers formed; in fact, the process is in actual operation today, notwithstanding it is presently too feeble to quite sustain existing glaciers, much less to augment them. However, all that

would be necessary to enlarge them would be increased precipitation of snow. On the other hand, occurrence of inconceivably vast continental ice sheets on low, flat lands in temperate zones and conditions which enabled them to form constitute an entirely different problem.

The theory that ice sheets originated on highland centers presupposes that innumerable mountain-type valley glaciers formed on those highlands; that the separate glaciers flowed down and out in all directions; that upon reaching lower, level lands, they spread laterally into "piedmonts"; that the piedmonts coalesced each with others and expanded until finally they constituted a continental ice sheet. It is claimed that thereafter the ice blanket continued to creep, advance and spread until, as in the case of the Pleistocene in North America, it reached south to the 40th parallel, north to the Arctic Ocean, west to the Rocky Mountains and east to the Grand Banks.

As to some ice sheets, there is doubt that centers of origin can be found whose altitudes above sea level were enough to permit accumulation of snow. The so-called Keewatin Center in Canada is such an instance. While it can be believed that snowfall might be so concentrated and so long continued on high mountains that it would form glaciers to flow down the sides and push out for a few miles on low, level lands below, it seems doubtful that snowfall could be so long continued and so narrowly concentrated on a "center" of low altitude in a temperate zone, such as the Keewatin Center, that it would become slowly compressed over the years into ice; that the ice would then gradually creep outwardly in every direction, not only downhill, but likewise uphill, across lakes and canyons, battling also summer heat, until at last it would form an unbroken blanket hundreds or thousands of feet deep, covering an area three thousand miles in diameter!

The writer has spent many weeks, both in summer and in winter exploring and observing mountain glaciers hundreds of miles north of the Keewatin Center. In late fall and early winter, before severely cold weather arrives, heavy snowfalls customarily occur. In summer, however, daytime temperatures

rise so high, even at altitudes of several thousand feet, that snow from the previous winter disappears completely, save for occasional deep drifts in sheltered places. Many mountain glaciers descend only to and terminate at altitudes of a thousand feet or more above sea level. Some valley glaciers on the ocean side of coastal mountains terminate before they reach the sea. If climate were colder enough to enable them to reach the sea, it seems probable that snowfall might be too much reduced to nourish them adequately.

Erratic Boulders

Proof that ice of continental ice sheets traveled great distances is supplied by "erratic" boulders whose sources have been found as much as several hundred miles from where the erratics now lie. However, as to erratics found in various regions on Earth—those found, for instance, in southern Ohio, Indiana and Illinois—there is evidence that they may have been "rafted" to their present locations by icebergs drifting in a former glacial lake. Usually the boulders are found in greatest abundance on or near the tops of hills. Often they are found in shallow "pot holes" which appear to have been gouged out by the rocking of melting bergs which stranded near the southern shores of the lake.

There are evidences that in Pleistocene time, at some stage of waning of the ice sheet, a vast lake occupied the above states between the termini of the ice sheets in the Great Lakes region and the Ozark ridge to the south. At that time, the Ozark ridge is thought to have extended east across the Mississippi Valley to the Cumberland Plateau. The present outlet of the St. Lawrence River was either blocked by ice or had not yet been opened through the mountain chain which once extended across the St. Lawrence Valley. The lake rose until it overflowed its southern banks and drained itself through the Mississippi spillway.

There can be no doubt that ice in the continental ice sheets must have flowed to an appreciable extent. Aside from the er-

atics, proof is also supplied by kames, eskers and moraines which the ice deposited; also by striations it chiseled on rock ledges, beds and boulders. But all such effects could have been accomplished by very little horizontal movement, certainly by much less than fifteen hundred miles.

Hypothetical Center

In considering the merits of the theory that ice sheets came from glaciers formed on "centers," let us create in our imagination an optimum of favorable hypothetical conditions under which mountain-type glaciers born on an "elevated center" could grow and creep outwardly and downwardly until they "coalesced" into a continental ice sheet, say, three thousand miles in diameter. Our ideal "center" of glacier accumulation will be like the ones others have visualized, except that ours is to be raised to a higher altitude.

We will first visualize a perfectly smooth symmetrical bowl, shaped like a saucer turned upside down and three thousand miles in diameter. We will place the dome at the "Laurentide center" in the Hudson Bay region of northeastern Canada. We will give it a liberal theoretical height, because we know the ice which is to form on it must travel a long way. Let us fix the height at $2\frac{1}{2}$ miles (13,200 feet), which is considerably greater than geologists believe the area had in the Pleistocene period. At this height the gradient down which the ice will have to flow from the top to a distance of fifteen hundred miles would be 1 to 600, which should be sufficient to sustain movement.

Now we shall imagine tremendously severe falls of snow concentrated over the center of the dome and enveloping a liberal area, say, five hundred miles in diameter. We shall assume that these snowfalls continue without a miss, all of every winter, from mid-September to mid-May, eight months of every year, for a thousand years. We shall assume that none of the snow and none of the ice subsequently formed from the snow, would melt during summer months, but that all of it would continue

to accumulate and that the ice would creep radially outward and downward from the center until it formed an ice sheet three thousand miles in diameter, with an average depth of two thousand feet. It is thought that the Pleistocene ice sheet was at least that thick and probably thicker.

By simple mathematics we easily determine that over the "center," five hundred miles in diameter, the depth of the average yearly accumulation of ice would have to be 72 feet. Seventy-two feet of ice is equivalent to at least 720 feet of snow. Hence, even with no allowance for summer melting, we see that tremendous snowfall, continued without pause for one thousand winters, would be required for ice to form on the above hypothetical "center" and "flow" outwardly in every direction until it formed an ice sheet covering an area equivalent to that which the Laurentide sheet is believed to have covered.

Spreading From Centers Questionable

It is impossible, for this writer at least, to accept the theory, even granting an optimum of favorable conditions, which we know did not exist. Extend the period of accumulation from one thousand years to twenty thousand, and the probability of concentrated snowfall on the center for that many successive winters would be even less. Shorten the period to five hundred years and the consequent required volume of annual snowfall would become more difficult to accept. Nor can the writer believe that the fantastic amount of water vapor required could be formed and raised to the skies in a climate so refrigerated that increments of winter snows would not melt in summers and so intemperate that ice could slowly "creep" southward, without melting, from northeastern Canada to southern Ohio, within forty degrees of the equator!

Furthermore, the reader can very easily demonstrate that ice flowing down the sides of a dome could never cover the whole surface. He need merely pour a soft batter over the center of a smooth bowl turned upside down. He will find that the liquid, thick or thin, will inevitably divide into separate streams

which will never spread sidewise to cover the whole area as the "coalescent theory" predicates. In compliance with the greater pull of gravity, the streams will flow downward instead of sidewise. Furthermore, they lack the capacity to cover the entire surface of the dome by reason of the fact that as they flow outwardly the area to be covered constantly increases in proportion to the square of the increasing distance from center. If the streams cannot spread sidewise and completely cover a perfectly smooth, symmetrical dome, how can we believe that separate valley glaciers would spread sidewise on broken, irregular, uneven terrain, containing hills, valleys, canyons, lake basins, etc., and coalesce until they would form an unbroken blanket covering an area of millions of square miles?

Of course the ice in a continental ice sheet must have "flowed" to some extent wherever the ground under it sloped. It would be subject to the same gravital forces which cause mountain glaciers to flow. Also, on level ground and even on ground sloping moderately upward, the thickness or height of the ice would cause flow for a considerable distance back from the terminal edge. However, to believe that ice formed in the Hudson Bay region flowed southwestwardly for fifteen hundred miles to Cincinnati, uphill and downhill, across mountains, over cliffs and canyons, battling also fierce summer heat, just does not seem possible even by the wildest stretch of imagination.

A More Logical Source

Rather, does it not seem far more logical and probable that when ice covered all of Canada and the northern third of the United States, it came from snowfalls which embraced the entire area—snowfalls which, save for vastly greater magnitude and intensity, were precisely like snowfalls occurring in those areas today? Likewise, when glacial ice completely covered Mount Washington in New Hampshire, whose summit is 6,000 feet above sea level, it came from snow which fell upon the mountain just as it does today. The ice was not pushed up the mountain, over the top and down the other side, from a vague

"center" of origin in Labrador, a thousand miles away, as the usual theory would have us believe.

Do not, therefore, logic and good sense urge upon us the conclusion that nothing less than an unearthly, extra-terrestrial fall of snow or ice could possibly have blanketed one-third of all land in both hemispheres at the same time, with ice hundreds, possibly thousands, of feet thick? The inconceivably vast quantity of moisture involved could not have been raised by solar heat, because the intensity of heat required would have prevented formation of snow and ice. On the other hand, had solar heat been so reduced that increments of earthly snows could have survived summer heat, water would not have evaporated in sufficient amount to form the snow.

An alternate theory of origin, to wit, that ice sheets came from highly abnormal snowfalls which embraced the entire glaciated areas, will acquire irresistible appeal, provided an adequate source for such unearthly precipitation can be disclosed, together with the revelation of conditions and natural laws which made such precipitation inevitable. Such an alternate theory of origin will be expounded later herein.

Climate in Past Ages

Now let us inquire what actual evidence exists to support the hypothesis that glacial ice accumulated slowly because of gradual deterioration of climate. Today there appears to be unanimous conviction among leaders in the field of paleontology that during by far the greater portion of time since the Azoic era, mild, benign climatic conditions have existed. It is also the concensus that, astonishingly and inexplicably, such conditions were comparatively uniform over most of Earth's surface; that temperate climate extended both north and south to within both polar circles. It is also believed that, amazingly, seasonal effects during most of geological time have been much less pronounced than they are now.

It is the concensus among leading scientists that such usually mild climatic conditions have been interrupted only occasionally,

only at irregular intervals, only for comparatively brief periods, and only during glacial epochs. Many quotations could be given to support these statements. Space permits only a few.

Dr. F. H. Knowlton, in *Relations of Paleobotany to Geology*, says:

Relative uniformity, mildness and comparative equability of climate, accompanied by high humidity, have prevailed over the greater part of the Earth, extending to or into polar circles, during the greater part of geologic time since at least the Middle Paleozoic. This is the regular, the ordinary, the normal condition.

Edward H. Colbert, in his paper *Vertebrate Paleoecology*, as reported by Howard Shapely in *Climatic Change*, says (p. 269):

So far as past climates can be interpreted from the record of fossil vertebrates, it would appear that during much of Earth history the world has enjoyed uniformly warm, equable climate over most of its surface . . . the general picture of past vertebrate life is that of warmth-loving animals living over wide ranges of latitude, from the southern tips of the continental land masses through the middle latitudes to regions as far north as the Arctic Circle.

John Wolbach, previously quoted, says:

Periods of widespread glaciation, separated by longer periods of mild climate, have apparently characterized the climate of the Earth for nearly two billion years.

Dr. Bell, also previously quoted, speaks of

the problem of the warm polar climate of non-glaciated periods, when temperate life forms flourished well within the Arctic Circle. . . .

She says further:

. . . the climate of the Tertiary began warm and mild, with temperate-type life far within the Arctic Circle . . . and coal-forming vegetation flourished on the continent of Antarctica.

Hardwoods in Polar Regions

Elso S. Barghoorn, in *Geologic Record of Plant Life*, writes:

The luxuriant growth of broad-leaf hardwood forests in high Arctic latitudes persisted from the Cretaceous into the Eocene and probably the Oligocene, indicating a prolonged continuation of humid, warm temperature, or at least temperate forest climate in polar regions. Evidence for this may be found in both Arctic and Antarctic regions. . . . The greater part of climatic history, evidenced by extinct floras and their distribution, appears to have been characterized by more equable distribution of temperature and also of rainfall. This geologically "normal" climate has been altered at long intervals by far briefer periods of polar ice and glaciation of the continents, even into middle and lower latitudes.

Admiral Byrd, writing in *National Geographic*, October 1935, about fossils he found on a mountain during one of his expeditions to Antarctica, says:

The rock fragments from this mountainside invariably included plant fossils, leaf and stem impressions, coal and fossilized wood. Here at the southernmost known mountain in the world, scarcely two hundred miles from the South Pole, was found conclusive evidence that the climate of Antarctica was once temperate or even sub-tropical.

While there is general agreement that throughout geologic time "the definitely zoned climatic belts, so familiar to us at the present time, apparently did not exist" (Colbert), every writer remains silent when it comes to offering an explanation for that mysterious anomaly. Later herein a precise explanation will be presented.

Is it not strange, that if glacial episodes developed because of slow, gradual deterioration of climate, their duration in every instance was so short and that usual conditions of warm, temperate, uniform climate returned so quickly?

As has been pointed out herein before, the aim of every

theory about ice ages has been to discover changed circumstances which could have caused climate to grow colder. To be tenable, any theory based upon colder climate must account for world-wide refrigeration affecting all zones of climate in both the northern and southern hemispheres at the same time; it must explain recurrence of cold-climate time and again at irregularly spaced intervals; it must account for the greatest accumulations of ice in specific regions; and it must account for the rapid return of temperate climate following each glaciation. Every theory thus far propounded has failed to meet these requirements.

Are widely held assumptions that climate grew gradually colder and that as a result ice sheets accumulated from winter snowfall, supported by actual, visible, concrete evidence? Or are the assumptions sustained only by longing and hope to verify them because they envision the one and only explanation of ice ages which anybody has been able to conceive?

Changes in Life Forms

It is evident that life forms changed radically at, or near, times of glaciation. It seems to be unanimously assumed that such changes took place prior to arrival of each ice episode. The theory that ice ages resulted because climate had deteriorated, obviously rules out any other conclusion. Three of the four major ice ages listed before, seem to have been dated fairly close to, if not in fact precisely at, the close of one era and the beginning of the next. The first major glaciation occurred between the Archeozoic and the Proterozoic. The second, between the Proterozoic and the Paleozoic. The third, between the Paleozoic and the Mesozoic. There appears to have been only a minor glaciation between the Mesozoic and Cenozoic. The fourth major glaciation, the Pleistocene, occurred only recently, late in the Cenozoic.

Fossil testimony indicates that at least some of the big revolutions in life forms were coincident with glacial episodes; but they do not prove that the changes necessarily *preceded* the ice. As Flint confesses (p. 524):

. . . although the occurrence of boreal animals and plants in and near the areas covered by the great Laurentide and Scandinavian ice sheets indicate a cold climate, it is impossible to determine [from the fossils] whether the climate resulted directly from world-wide reduction of temperature or whether it was in part a secondary effect resulting from the incursion of the ice sheets.

However, both logic and evidence support the view that changes in life forms followed *after* and *because of* the arrival of the ice.

Climate Changed Abruptly

Now there most assuredly is strong evidence that terrestrial climatic conditions changed suddenly rather than gradually. Coleman, in *Ice Ages, Recent and Ancient*, writes:

During the Cretaceous, the last division of the Mesozoic, when warm, temperate forest grew in Northwestern Canada, the dinosaurs of the Red River Valley in Alberta lived and died by the thousands, so that their skeletons are thickly scattered over the "bad lands" along the river. . . . Suddenly, at the close of the Age, the reptiles of sea, land and air disappeared without leaving a remnant; and the coming in of the Eocene . . . rid the world of the races of monstrous reptiles. . . . It was the most dramatic transformation in the history of life on Earth and more than one [futile] attempt has been made to account for this surprising turn of the tables between the two classes of land vertebrates [reptilian and mammalian].

Colbert says (paper #21 in Shapley's *Climatic Change*) that although the extinction of the dinosaurs and the sudden appearance of many groups of mammals were almost instantaneous events in terms of geologic time [at the close of the Mesozoic and the beginning of the Cenozoic], it is hard to believe that climates at the beginning of the Cenozoic were widely different from those that characterized the close of Mesozoic times. . . .

Other similar drastic and mysterious disappearances of contemporary life forms and replacement by new ones have occurred at the end of one era and the beginning of the next. In

fact, the very changes in life forms are used to divide and separate the eras one from another.

Darwin, the great exponent of uniformitarianism, thought it strange that forms of life changed simultaneously all over the globe. As Immanuel Veličkovsky says so beautifully in *Earth in Upheaval*:

Great multitudes of animals that filled prairies and forests, water and air, forms fragile or sturdy, with an urge to live and multiply, were more than once suddenly called upon to write their names in the register of extinction. . . . It is quite futile to look to changes of currents, climate or other physical conditions as the cause of these great mutations in the forms of life throughout the world. . . . Entire species, with no sign of degeneration, suddenly came to their end in paroxysms of nature.

In reference to destruction of species at ice ages, L. C. Eiseley, of the University of Kansas, wrote in *American Antiquity*:

We are not dealing with a single, isolated, relict species, but with a considerable variety of Pleistocene [Ice Age] forms, all of which must be accorded, in the light of cultural evidence, an approximately similar time of extinction.

That mysterious, extensive change in faunal and floral life of land, sea and air have occurred repeatedly at irregular intervals in Earth's history, is generally believed by paleontologists. There is entirely too much evidence that such changes were sudden and catastrophic to be nullified simply by slavish adherence to the concept of uniformitarianism. What else, other than violent abrupt changes in climate, could account for such pronounced changes in life forms. Only failure to envision a possible cause of sudden changes has generated doubt that they occurred. The theory hereinafter to be propounded will disclose the adequate cause.

Ice Appeared Suddenly

In spite of long continued efforts to prove that ice sheets accumulated because climate had deteriorated, little if any actual evidence has been discovered to validate the theory. On the contrary, there is evidence that glacial ice appeared with catastrophic suddenness. There is evidence that at a time when temperate climatic conditions extended even into polar regions, the world, teeming with warmth-loving species of floral and animal life, was overwhelmed by fall of snow, ice and rain, so violent, so sudden, so chilling, that great numbers of creatures were forthwith destroyed; so vast, so violent that it brought to an abrupt end one geologic age and ushered in another. In many areas over the globe fossils of the buried dead eloquently testify to the suddenness and violence of the catastrophe which destroyed them. We even find it quite unnecessary to rely only upon skeletal remains. We are given the amazingly conclusive evidence of complete bodies, not just bones, of mammoths, rhinoceroses and other mammals which were destroyed and put into the deep freeze of arctic, glacial ice so suddenly that grass, branches and leaves of hard-wood trees they were eating at the moment did not have time to digest! Repeatedly, perfectly preserved bodies of these beasts have been found in clear, blue, glacial ice, both in Siberia and in Alaska. According to Kotzebue, one was even found embedded in an iceberg floating in the sea!

Digressing for the moment, this fact pointedly suggests that the agency which killed these beasts was falling ice, rather than soft snow. We have all seen some pretty heavy snowfalls, but it is difficult, if indeed not impossible, to imagine one of such intensity that it could destroy a huge, powerful mammoth so suddenly that food he was eating at the onset of the storm would not have time to digest before the soft snow killed him.

Explorers have reported that the northern portions of Siberia, well within the Arctic Circle, and also the islands off its coast, are a veritable charnel ground for countless thousands of beasts of various warmth-loving species. It is said there are hills 300

feet high made up in great part of whole carcasses of mammoths, deer, rhinoceroses and other mammals cemented together by frozen mud and ice; that there are hills equally high composed of broken tree trunks mixed with frozen soil in wild confusion as if they were thrown with great violence by gigantic flood waters coming from the south. Granting some exaggeration in such tales, the essential facts have been corroborated. It is well authenticated that northern Siberia has supplied great quantities of fossil ivory for world trade, obtained from the frozen remains of mammoths.

It seems illogical to deny the sudden, catastrophic arrival of the snow, ice and water which destroyed these creatures; or the decisive evidence that climate at the time was far milder within the Arctic Circle than it has been since. Those who entertain the theory that a gradual decrease in climatic temperature caused the ice ages and that glacial ice accumulated slowly from ordinary winter snows, have always soft-pedaled or completely ignored the refutation of their theory which the above evidence supplies. It seems petulant to dispute the evidence by claiming that the animals merely strayed from warmer climes in search of food, and fell to their deaths from cliffs or into crevasses. There have been far too many carcasses found in far too many places to support such claims.

Ice Caused Climatic Change

Let the reader dwell for a moment on what the foregoing facts clearly indicate. Entire, flesh-covered bodies of temperate- and subtropical-type animals have been frequently found within the Arctic Circle, frozen in glacial ice, with undigested grasses and hard-wood-tree leaves in their stomachs, their flesh preserved, with no sign of putrefaction, thousands of years after their death. Does this not decisively prove that the ice itself must have caused, and caused suddenly, the climatic change which occurred? Obviously the change could not have occurred before the ice appeared, for in that event warmth-loving animals and vegetation would not have been there. Does the evi-

dence not definitely prove that at least Pleistocene glaciation did not eventuate because climate had grown gradually and slowly colder? Is it not obvious that the incredibly vast mass of ice which we know existed, ice hundreds or thousands of feet thick, distributed in both hemispheres and covering a combined area equal at least to one-third of all land now on this globe, was quite sufficient to affect drastically Earth's climate?

It is perhaps natural for one thoughtlessly to assume that ice ages eventuated because climate grew colder, for it is cold that forms ice; but if he will but reflect upon implications of the foregoing evidence, and recall that low temperature reduces evaporation and precipitation, he can scarcely fail to conclude that the above evidence should definitely and for all time lay the ghost of that illogical and untenable assumption. Surely the evidence indicates irrefutably that an avalanche of ice or snow suddenly descended upon and buried in an icy tomb a world teeming with temperate species of animal and vegetable life, luxuriating up to that very moment in a mild, benign climate, even within the polar circles!

What reason other than abrupt, catastrophic falls of snow, ice and chilling rain can possibly be imagined to account for sudden, world-wide extermination of teeming faunal and floral life of land, sea and air? Granted that evidence furnished by frozen mammoths is restricted areally, yet there are signs of abrupt disappearance of life forms in many other regions on Earth. The evidences of sudden climatic changes are more numerous and far more definite than are the indications of a slow, gradual change. As has been suggested before, is it not possible that the concept of gradual deterioration of climate is championed because no other cause of glaciation has been conceived?

Summary of Conclusions

Let us now review our conclusions up to this point.

(1) Although it is certain that the ice sheets covered great areas in temperate and even subtropical zones, it cannot honestly be thought that small annual increments of winter snowfall could survive summer heat in such regions.

(2) If Earth's climate were refrigerated so drastically that increments of winter snow in temperate and subtropical zones would not melt during the following summers, evaporation of surface waters would be so drastically reduced that snowfall would be virtually eliminated. Hence enormous accumulations of snow and ice could not eventuate.

(3) Evidence is decisive that glaciation took place suddenly, without warning. Therefore, the moisture in the glaciers must necessarily have been aloft in toto at the time it fell.

(4) Because of frequent rains and snows, water vapor could not remain aloft until the required amount had accumulated.

(5) Had the total required amount of vapor been driven aloft by solar or terrestrial heat so rapidly and so far that rain and snowfall could not have prevented the required accumulation, the terrific heat would have prevented accumulation of the ice.

The foregoing points force the conclusion that the tremendous quantities of water involved must have been assembled in space so far above Earth as to have been free from the influence of fluctuations in atmospheric temperatures and currents which cause rain and snowfall; also that the water could not have been driven to such heights by any agency which could have been in existence under terrestrial conditions which we know were characteristic of the periods just preceding the various ice ages.

In the foregoing analysis of theories and evidence the writer has endeavored to avoid deductions which logic fails to support and statements which do not agree with facts. If anybody seeks to refute the conclusions, the writer hopes the attempt will not

be motivated by dogmatism but will be because of proof that the conclusions are erroneous. It is hoped that no attempt will be made to discredit the conclusions only because they violate old, threadbare theories which have long since been decisively repudiated.

A Fresh Approach Necessary

Although it seems incredible, it is, nevertheless a fact that among thousands who have tried to solve glacial mysteries, only three basic concepts previously mentioned have been conceived, to wit: one, that refrigeration of climate was the cause; two, that ocean water was the source of moisture; and three, that the ice sheets accumulated slowly from surviving remnants of winter snows.

Persistent pursuit of these concepts for more than one hundred years has utterly failed to solve the mysteries. Surely, therefore, it should be evident at long last that the premises must be fundamentally false and that we will have to look elsewhere for the solution. However, because they are intimately associated with the true cause of ice ages, let us first investigate secrets which the oceans are keeping from us—secrets no less mystifying than the phenomenon of ice ages.

CHAPTER TWO

OCEANIC MYSTERIES

Lower Sea Levels

AS HAS BEEN MENTIONED, it is the concensus that Earth's oceans supplied the moisture with which glaciers were built. No other source is suggested or apparently conceived. According to this concept, the ocean level must have been lowered considerably during each glacial epoch. That ocean level has in fact very evidently been lower in the past than it is now, as cited as proof that the theory is correct.

Estimates vary as to the probable amount of regression of sea level supposedly caused by imprisonment of water in the ice. A low estimate of 70 meters is considered inadequate. Generally it is thought that the amount of lowering was about 200 meters. Dr. Francis P. Shepard in *Submarine Geology* suggests a possibility of 1,100 meters. Most geologists believe that the latter estimate is excessive. Yet, according to Veatch and Smith, there is definite evidence that the sea level was once as much as two miles lower than it is at the present—three times as much as anybody has estimated as result of glaciation!*

Of course, it is evident that the ocean level must have been recently raised by the melting of immense continental ice sheets. In fact, the process is continuing as of this moment, due to shrinking of remaining glaciers and ice caps. However, it is now generally doubted by glacier students that the volume of water involved in any ice age was anywhere nearly enough to account for the sea level being two miles lower than at present.

* *Atlantic Submarine Valleys of the United States and Congo Submarine Valley*; Special Paper #7, Geological Society of America, 1939.

Flint says sea level during the maximum of Pleistocene glaciation was not more than 120 meters lower than now. He labels an estimate of 276 meters by Ramsay as excessive. Professor Charles Merrick Nevin of Cornell, in *Principles of Structural Geology*, says: "there does not seem to have been nearly enough ice during the glacial period to account for a drop in sea level of several thousand feet." While such doubts do not prove that glacial ice did not come from surface waters, they do definitely leave unexplained the greatly lowered sea levels which are known to have existed in past geological ages—levels as much as 10,000 or 12,000 feet lower.

At least four former terraces or strand lines have been found off continental platforms in several places around the world. P. H. Kuenan, in *Marine Geology*, states that Veatch and Smith showed the existence of an ancient "Franklin Shore" at 70 to 110 meters depth on the Atlantic Shelf of North America. He says:

Bourcart found three terraces, one below another, along the eastern Atlantic border, the deepest of which, at 500 to 1,000 meters, he judged to be of Mio-Pliocene age, one at 200 to 500 meters is supposed to be Upper-Pliocene, while the terrace at 0–200 m. is of composite age from Mid-Paleolithic to Recent.

All continental platforms are completely surrounded by gently sloping submerged land borders called continental shelves. They average about 100 miles in width and slope gently from shore seaward to an average depth at their outer edges of about 450 feet (von Engel and Caster). Some writers say, 100 fathoms—600 feet. At the outer extremity of the shelves, the so-called continental slopes begin. With sharply increased gradients these slopes extend downward for some 12,000 feet to the abyssal ocean floors. Their slopes, in form and gradient, approximate those of rugged mountain ranges on land.

Submarine Canyons

Both shelves and slopes are furrowed by thousands of gullies, valleys and steep-walled "submarine canyons." Many of the latter obviously are extensions of present river valleys. Some have tributaries with a dendritic pattern, just like those of river systems on land. They cross the shelves and incise the slopes, in some cases to a depth of 10,000 or 12,000 feet! The walls of the gullies and canyons in most instances are stratified, sedimentary rock, although in some cases they are crystalline, granitic, igneous rock. The upper strata contain fossils dated as late as Tertiary or even Quaternary.

Flint says that unconsolidated sediments on the continental shelves do not customarily grade from coarse to fine outwardly from shore as water-borne terrigenous sediments do. He points out that the sediments include wind-borne sand at depths of 180 feet. He interprets those and other characteristics as indicating that the shelves are of subaerial deposition and have been submerged only recently. The deep gullies and canyons in the solid rock floors of the shelves and slopes point to long continued erosion preceding submersion.

Those who espouse the theory that oceans supplied the moisture for glacial ice ask us to believe that the shelves were temporarily exposed because water which formerly covered them was locked up in ice sheets. In order for the great amount of known erosion to have taken place during the interim, the shelves would have had to remain exposed for millions of years and the ice sheets would have had to endure for an equal period before beginning to melt and release water to submerge the selves again. This does not accord with the fact that glacial periods were of short duration. It is believed that all four stages of Pleistocene glaciation embraced less than a million years from start to finish. The last stage is thought to have been at its maximum a mere 25,000 or 30,000 years ago.

Certainly the lapse of time since then was far too short for rains and rivers flowing over the exposed shelves to cut the

rock-walled gullies and canyons which exist in them; or for the detrital and fossiliferous remains to accumulate. In rebuttal, it might be argued that the shelves were exposed time after time during different glacial episodes; hence the erosions and fossils were cumulative results from successive short periods. That rivers which eroded the canyons would return to their identical previous locations after interglacial intervals of hundreds of thousands of years, to resume the interrupted erosions of the very same canyons, seems so improbable as to rule out the notion.

But granting that gullies and canyons in shallow continental shelves were in fact eroded while the shelves were exposed during glacial episodes, we are left with no explanation of how submarine canyons in the deeper continental slopes were eroded to depths of two miles below present sea level. Glacial ice may have been sufficient to lower oceans 500 or 600 feet—the maximum depth of the shelves—but nobody expresses a conviction that the ice could have lowered the oceans 10,000 or 12,000 feet.

The considerable length of time which must have been required for stream erosion of deep canyons in solid rock, plus the fact that Pleistocene ice was insufficient to lower the oceans two miles, seem to be decisive proof that the gorges necessarily must have been eroded prior to Pleistocene glaciation; also during a long interglacial interval rather than during a short glacial episode.

Origin of Canyons Unsolved

Volumes of guesses have been made and published as to how submarine canyons could have been produced. Theories include submarine "turbidity" currents of muddy water; artesian-spring sapping; submarine solution; tsunamis; slumping; diastrophism. All students of the mystery continue to mull over those theories; but it is safe to say that not a single one has been accepted as valid. The prevailing feeling is that the canyons have been incised by rivers working over a very long geological period while

the slopes were above water. Yet it seems that most students cannot confidently accept such an explanation because nobody has produced a plausible theory as to how all continental shores, world-wide, could have been raised simultaneously, or how ocean level could have been lowered by 10,000 or 12,000 feet.

P. H. Kuenan, in *Marine Geology* (p. 499), definitely rejects the theory of subaerial erosion of canyons, followed by drowning due to down-warping in very recent time. He says the theory would mean that up to the end of Tertiary time continental slopes were in approximately the same position as they are at present and that a temporary emergence occurred during the cutting of the canyons. He says that no one could attribute such swift, regular and universal uplifting, followed by a downward movement of like extent, to normal diastrophism.

Shephard (*op. cit.*) says that evidence points to world-wide changes of sea level, but the magnitude of the changes causes hesitation in accepting the conclusion. He says further:

still greater difficulty appears to lie in the path of any conclusion that the continental margins and ocean basins have been undergoing tremendous oscillations in comparatively recent geological times and especially that they have now all been submerged. This is a serious predicament and requires much thought and still more investigation in the field. Whatever we find, the indications are that something has been radically missing from our knowledge of past geological conditions.

Von Engeln and Caster in *Geology* (p. 320) say:

If the submarine gorges, world-wide in distribution, are truly stream-eroded, geologic science is confronted with alternatives none of which seems possible of realization. One is that sea level in recent times has been 10,000 feet lower than now. The other is that coastal lands of all the continents have been 10,000 feet higher than now; or possibly that sea level was 5,000 feet lower and the lands were 5,000 feet higher than now; or some other proportion of the lowering of sea level and the raising of coastal lands to account for the 10,000 feet.

They label all these concepts as fantastic, yet admit that greatly lowered sea levels are clearly indicated.

Professor Nevin of Columbia, in *Principles of Structural Geology*, says with reference to the canyons:

Since they are restricted to the marginal zone, are of world-wide extent and attain about the same accordant levels, the evidence appears to be in favor of an origin controlled by a eustatic change of sea-level. The stumbling block, of course, is a valid cause that would change sea-level the necessary thousands of feet.

Thereupon he discounts the possibility of such great eustatic change by saying: "The facts point clearly to the very old age and permanence of the continental blocks. . . ." He points out that if uplift of the continents or of the marginal zones is imagined, so as to permit subaerial erosion, all the marginal zones must have been up-lifted the same amount and to the extent of ten or twelve thousand feet.

After erosion of the canyons, *all* the marginal zones must have been lowered the same amount and returned precisely to their former (and also present) positions. All this must have happened very recently.

He says further:

The volume of the ocean must be taken as constant, unless an ice age is assumed. But there does not seem to have been nearly enough ice during the glacial period to account for a drop in sea-level of several thousand feet. . . . The problem of the origin of submarine canyons is apparently unsolvable with the present data. Unfortunately we cannot retreat into the security of the distant past, when called upon for an explanation of their origin. The actuality of the submarine canyons savors almost of a joke on the part of Nature.

Other Evidence of Lower Sea Levels

Evidence of former lower ocean levels is not limited to submarine gullies and canyons. In all oceans there are submerged islands, mountain ranges and volcanic peaks which bear unmistakable effects of subaerial sedimentation and weathering. In the Pacific, there are hundreds of volcanic peaks, many of which are submerged to approximately uniform depths of about 800 fathoms—nearly a mile. These sea mounts, called "Guyots," have flat truncated tops believed to indicate subaerial ablation at a time when the peaks stood above sea level. The great mid-Atlantic submerged ridge which extends for 9,000 miles, almost from Iceland to Antarctica, is believed to have once been above water. It stands some 15,000 to 20,000 feet above the ocean floor and many portions are covered by only a few hundred feet of water. The Azores, Ascension and many other islands are protruding portions of this ridge. Thousands of islands throughout all oceans are but small, exposed portions of much larger land areas which formerly stood above water.

With regard to wind-blown sands submerged two and three miles on the sea bottom of the Atlantic, 1,200 miles from land, Professor Ewing, in *National Geographic Magazine*, November, 1949, says (p. 613):

Either the land must have sunk two or three miles or the sea must have been two or three miles lower than now. Either conclusion is startling. If the sea was once two miles lower, where could all the water have gone?

Many inland seas and partially enclosed basins have erosions in their banks far below the sills which intervene between them and the open ocean. For instance, canyons of the Mediterranean banks, according to Shepard, are a mile deep; yet the sill at Gibraltar is only 400 meters below sea level. Brooks says that the Mediterranean canyons are 400 meters and those of the Japan Sea 200 meters below the respective sills of those seas. Kuenan's figures differ somewhat from those of either of

the above quoted gentlemen. He says in *Marine Geology* (p. 509), that the canyons of the Mediterranean descend at least 500 meters below the sill and that those of the Japan Sea extend 1,000 meters below sill depths. Although the statements vary, they all testify that the canyons continue down very considerably below the sills. As in the case of canyons on the shores of the open oceans, erosions in the shores of the inland seas have defied all attempts to explain them.

The floors of many shallow embayments show conclusively that deposits on them accumulated prior to present submergence. Submerged forests found on coasts in many places around the world, are prima-facie proof that their submergence occurred after the trees had grown, either because of subsidence of the land or because of encroachment by a rising sea level. In such cases, however, the extent of submergence is insignificant—limited to a few fathoms—which could very well have been due to melting of Pleistocene glacial ice. Significant evidences, which primarily concern us, are those which indicate former levels thousands of feet below the present levels.

Raised Strand Lines

Neither are we concerned about raised strand lines found here and there. Such formerly raised beaches should not be taken to indicate that oceans once stood higher than at present. They are localized, limited to but a few feet, are variant in height and often out of level. In the latter instances they can logically be ascribed to isostatic adjustment following removal of the burden of glacial ice. In other cases they were clearly caused by orogeny.

Untold billions of tons of sediment which rivers have carried to the seas have caused ocean floors to sink and the borders of land platforms to rise. Such adjustments will continue so long as rivers flow; but they do not nullify decisive evidence that ocean level has been raised thousands of feet within geological time.

Three Causes Envisioned

Only three possible causes of former lower sea level have been envisioned. One is that the water was imprisoned in the ice sheets during glacial episodes. As we have noted, this hypothesis is definitely refuted because of the great magnitude of the difference in level. The other two possibilities which have been suggested are: one, that continental platforms were temporarily uplifted; two, that ocean floors had temporarily subsided. As noted in our study of submarine canyons, grave doubts exist that land platforms could have bobbed up and down enough to account for the fluctuations. Various geologists have said in effect: "You cannot make me believe that the continents have moved up and down 12,000 feet in the very last geological episode."

Subsidence of Land Platforms

The theory that ocean levels have been raised because continental masses have subsided is questionable because evidence proves that ocean waters have crept higher upon and over land surfaces to the same extent and at the same time all over the globe. Would it not be multiplying probabilities a bit too much to assume that land areas everywhere on Earth sank simultaneously and to the same extent, to account for world-wide and uniform rise of ocean level? Furthermore, had this happened, ocean floors, under the physical law of isostatic equilibrium, necessarily would have had to rise concurrently, thereby decreasing ocean depths. But the latter did not happen. Ocean depths, instead of decreasing, very obviously and irrefutably have increased!

Subsidence of Ocean Floors

To account for submergence of mid-oceanic islands, ridges and sea mounts, the very same idea is advanced as is used to explain the rise of waters over continental shelves and slopes. It is alleged that those mid-oceanic lands, together with the ocean floors upon which they rest, have sunk. It is said that a former mid-Pacific continent, some 1,200 miles broad and 2,000 miles long, sank more than 3,000 feet. Is it not perfectly obvious that subsidence of such a large land area by even much less than 3,000 feet would have withdrawn waters all over the world from the shores of other lands which did not sink, and would have increased the gradient of every river on Earth which empties into the sea? There is no doubt that the very opposite of this has transpired. Ocean waters have climbed higher upon lands all over the globe and the gradients of river estuaries everywhere obviously have been decreased. At the same time former islands in all oceans have been submerged.

Concepts Contradictory

It would seem inconsistent to believe that former mid-oceanic lands have been submerged because ocean floors have sunk and at the same time to maintain that oceans have encroached upon continental platforms because the platforms have sunk! The two concepts are contradictory. If one is true the other must be false. In other words, if the African coast at the Congo, the Pacific coast at La Jolla and the Columbia, the Atlantic shore at the Hudson, the coast of India at the Ganges and Indus, the Brazilian coast at the Sao Francisco, together with land borders at numberless other places around the globe, sank into the sea after the submarine canyons at all those places were eroded, then all ocean floors must necessarily have risen simultaneously in order to maintain isostatic equilibrium of the globe. How then can it be that ridges, islands and mountain peaks which rise from mid-ocean floors in every ocean were also submerged and still remain submerged, just as the continental borders

were drowned and still remain drowned. Obviously the ocean floors did not rise; and if they did not rise, the platforms could not have sunk.

Although, as we have noted, Nevin, among many others, considers the mystery of fluctuating sea levels and submarine canyons unsolvable, he definitely rejects the idea of large-scale uplifts and subsidences of ocean floors and continental platforms. He says (*op. cit.*, p. 296):

No large-scale crustal deformation that would either greatly reduce or greatly increase the capacity of the ocean basins has occurred. The raising of land bridges big enough to span the Atlantic and the dropping of land areas the size of continents down to the ocean floor are refuted.

Yet without doubt, continental borders and oceanic islands which stood thousands of feet above sea level for millions of years are now submerged as much as two miles. There must be a credible explanation!

Solution Must Be Sought Elsewhere

When analyzing theories about the origin of ice ages, we found that the only cause which has been conceived is colder climate. We noted that persistent study of glacial phenomena for more than one hundred years, from Agassiz on, based upon that premise, has utterly failed to produce an acceptable solution. Yet no alternate cause has been suggested.

Regarding the mystery of former lower sea levels, we now find that, as in the case of ice ages, many years of study have failed to produce an acceptable solution. We saw that only three possible causes have been advanced. None has received general acceptance. Are we not forced to conclude, as we did in regard to ice ages, that we must look elsewhere for a solution? If we find the answer to the mystery of lower sea levels, perhaps we will also have discovered at the same time a solution of the phenomenon of ice ages. In the next chapter we shall attain both goals.

CHAPTER THREE

THE TRUE ORIGIN OF ICE AGES

Startling New Thoughts

IN APPROACHING THE FRESH THEORY now to be advanced regarding the cause of ice ages, the reader must first abandon the idea that colder climate was a prerequisite for the advent of an ice age. Rather he must accept the thought that prior heat—tremendous, implacable, unearthly heat, far greater than the puny modicum of solar heat received by Earth—was absolutely necessary to set the stage for a glacial episode. It seems almost incredible that this conception has so long and so completely escaped comprehension. There is nothing whatever fantastic about it. It is based firmly upon scientific principles and laws of Nature. It is logical and should long since have been envisioned. But it is only when combined with the following new conception that its terrific impact becomes apparent.

The reader must next abandon the orthodox obsession that Earth's oceans have always been as wide and deep as they are now. He must accept, instead, the verdict, disclosed by a limitless fund of evidence, that Earth's hydrosphere has been repeatedly augmented during geological time and as recently as the Pleistocene.

The very instant these two revolutionary thoughts enter a person's consciousness, a veritable flood of light comes pouring into his mind to illuminate a host of mysteries in Earth's evolution which, up to that time, had remained shrouded in utter darkness. It becomes immediately apparent that they constitute the key to the true solution of glacial and many other geological phenomena. Failure to comprehend these two fundamentals has

delayed solution of a host of Nature's mysteries for more than one hundred years.

On previous pages the following conclusions were reached: (1) that nothing short of world-wide, unearthly falls of snow or ice could possibly have created the inconceivably vast mass of ice which was contained in world-wide continental ice sheets; (2) that in order for such tremendous downfalls to occur, the incredibly vast amount of required moisture would first have to be present in toto in space above; (3) that the intensity of solar or terrestrial heat which existed on Earth just prior to any of the ice ages, as proved by animal and vegetable fossils, was quite incapable of accomplishing such a tremendous result. Therefore, we conceived the first new concept, to wit, that only primitive heat, which existed during formative eons in Earth's evolution, could have been the force which repelled such an astounding amount of moisture to space above.

Potent and revolutionary as that new concept is, the second new thought, that the amount of water on Earth has been increased within geological time, is perhaps the more significant and, no doubt, the more startling. Orthodox geological teaching insists that all other phases of terrestrial evolution required the lapse of eons; but as to accumulation of the hydrosphere, it rather inconsistently holds that all water descended to Earth's surface in toto as soon as cooling of the crust permitted water to remain. Nevin (p. 292) expresses the prevalent belief and teaching when he says: ". . . the ocean is one of the oldest features on Earth. As soon as the crust cooled sufficiently, the ocean appeared. . . ." It requires but a moment's thought to realize that had this been true, results would have been directly contrary to those which obviously have taken place.

Water Content of the Crust

Analysis of the various kinds of rock under land surfaces discloses that they contain water to the extent of from one-half to ten percent of their volume, the average being about five percent. Undoubtedly, also, interstices in the crust—pores, fissures,

caves, etc.—contain in toto an enormous quantity of water. A tiny four-inch hole drilled on land at any spot in the world to an average depth of not more than 100 feet, will encounter water; whereas on the surface of land the average distance from one stream or pond to another will average probably a score of miles. It would almost seem that there is more water underground than there is above!

There can be no doubt that Earth's waters are still being gradually absorbed into the crust, and coming ages will certainly diminish the volume of the oceans. (Will rocks continue to drink until some day Earth's surface will be as dry as is that of the moon? Perhaps!) If but the first 25 miles in depth of Earth's outer shell has imbibed water in the amount of only 2½% of its volume—a mere half the average for rocks near the surface—there is enough water in that shallow portion of the crust to raise the ocean level some 3,300 feet! Of course this suggested percentage may be nowhere near the truth; but surely water penetrates more deeply and accumulates to a greater percentage in rocks beneath ocean floors than it does beneath continental platforms. It does not seem fantastic to assume that absorption by chemical and physical processes combined may have occurred to the extent mentioned.

We can all agree that if and when Earth's core was igneous, all water must necessarily have been vaporized and repelled from the core to some unknown, but great distance above. If all this vapor condensed and descended at once when heat ceased to repel it, as suggested by Nevin, it follows from the foregoing reasoning and computation that originally the oceans must have been so much deeper than they are now that very, very little or no dry land existed. Yet, quite to the contrary, every bit of evidence indicates unmistakably that throughout the whole of geologic time ocean levels have been lower and dry lands have been larger than they are now.

Water From Volcanism

So far as this writer has been able to discover, there has been only one inkling of suspicion that any increase in the amount of water on Earth could have occurred since the beginning. This one suspicion is that perhaps the hydrosphere has been augmented by water emitted in volcanic eruptions. This suggestion has been advanced in an attempt to account for the fact that sea level in past times obviously was much lower than it is at present. Kuenen concludes, from computations he made, that the total increase from volcanic sources is insignificant. In any event, it seems quite impossible that enough water could have been spewed out of Earth's bowels by volcanoes to raise sea level 10,000 or 12,000 feet. On the face of it the suggestion appears to approach the preposterous. It merely illustrates to what illogical ends blind groping for a solution can lead. In vain may one search the pages of both early and late geological literature for the slightest hint, other than the above, that the hydrosphere now differs, in gross amount, one drop from what it was at the beginning of geological time! Nevin says (p. 292): "Certainly during the past billion years . . . there has been little change in the total amount of ocean water."

Students Frustrated

Adhering to the theory of hydrospheric permanence, nobody has been able to solve the mystery of how ocean level, within recent time, has been 10,000 to 12,000 feet lower than it is now. The phenomenon of submarine canyon erosion, of submerged continental shelves and slopes, of concomitant drowning of mid-ocean ridges, sea mounts and islands, the source of waters which produced epeiric seas and "pluvial periods"—these and other geological mysteries still remain unsolved after a hundred years of study. Yet all students monotonously begin, pursue and conclude their efforts to solve the puzzles, still clinging to the obsession that the hydrosphere has always been the same in total

volume as it is now. It is because of this one-track pursuit that they meet with frustration.

Is it not strange that assumed ocean permanence has never been questioned? Is there anything illogical, unscientific or incredible in the idea? Certainly many thalassic puzzles which have defied solution for a hundred years would be explained if it could be decisively shown that ocean waters have in fact been increased within geologic time. There is ample evidence that such increases have occurred, but the true meaning of the evidence has not been recognized because nobody has conceived that increases could have happened. Hence there remains only the need to disclose the possibility of increases and the manner in which they came about. The theory to follow will do both. Furthermore, it will prove that increases were inevitable due to inexorable functioning of natural laws of motion and gravitation.*

Inspiration From the Planets

In developing a theory of how hydrospheric increases could have come about, we are obliged, frankly, to start with assumptions. However, we do not have to postulate bizarre, fantastic ones, cut out of wholly imaginative cloth. Fortunately, we are able to base them upon logic, known facts, Nature's laws and,

* As this book goes to press an announcement has just been made from Antarctica which proves that ocean level at the beginning of the Pleistocene ice age was thousands of feet lower than it is now. It has just been determined that Byrd Station in Antarctica, 5,000 feet above sea level, is situated on an ice sheet 10,000 feet thick. Thus the ice rests upon terra firma 5,000 feet below sea level! Hence sea level, before Pleistocene ice was deposited, must have been several thousand feet below the present level. The ice sheet would not have formed had the snow or ice fallen into ocean water several thousand feet deep. The weight of the ice probably depressed the land somewhat, but not to the extent of 5,000 feet. The foregoing discovery clearly disposes of the idea that former greatly lower ocean levels were due to sea water being frozen up in the ice sheets. Furthermore, it very definitely lends substantial support to the theories expounded in this book.

most inspirational of all, upon things and conditions we can actually see.

Inspiration is immediately forthcoming when we take our telescopes and look up into the sky at Earth's sister planets—other worlds, if you will, but belonging to one and the same system, doubtlessly formed in the same way of identical substances, floating majestically in plain sight for all to see—actual, visible, perfect examples of other worlds in various stages of exactly similar evolution. In any attempt to ascertain how Earth evolved, where could we hope to find more helpful, more trustworthy, more specific information than that supplied by other planets. No theory fabricated out of mere imagination could possibly hope to equal it. It is incredible that lessons clearly taught by conditions plainly visible on other planets have so completely escaped comprehension. Not only do those conditions inspire the true conception of how ice ages occurred and how oceans were augmented, but they also afford an explanation of certain mysteries about the accumulation of Earth's super-crust.

Now what do we see when we look up at other planets? We see Jupiter, Uranus, Neptune and Venus completely shrouded by enveloping cloud mantles. We see Saturn not only similarly shrouded, but also surrounded by a system of several discs or rings. The outside diameter of this ring system is some 173,000 miles. The inside diameter is about 111,000 miles. The inner edge of the innermost ring is between 18,000 and 20,000 miles distant from the cloud envelope which obscures the planet itself.

It is conceded that we have never seen the solidified core of any of the above planets. Hence we cannot determine the diameters of the planets themselves nor the periods of their rotations. We know definitely that what we do see are tenuous, cloudlike, atmospheric masses of mineral matter. These cloud covers, at least of Jupiter, Saturn and Uranus, are striated with latitudinal bands from their equators both ways to the poles. There are apparent rifts, gaps or divisions between the bands. The atmospheres in all cases are visibly rotating.

Jupiter's Atmospheric Envelope

In the case of Jupiter, which is near enough for accurate determination, we have been able to gather considerable detailed information. We have accurately measured the periods of rotation of its bands. We know that those near the equator complete a revolution in less time than do those toward the poles. We, therefore, know that the bands are rotating independently of each other and independently of the Jovian core. While Jupiter's bulk is 1,300 times, its weight is only 317 times that of the Earth. The equatorial diameter of its cloud cover is nearly 87,000 miles. The clouds move with a velocity of about 27,000 miles per hour. It is thought that Jupiter must have a dense, solid core considerably larger than that of the Earth. We know that its cloud cover is tenuous.

It seems logical to assume, in accord with laws of momentum, that the core, being a great deal larger than Earth, Mars and Mercury, probably rotates more slowly, surely no faster, than do those three planets. The visible, outermost portions of the cloud cover complete a revolution in about ten hours, or perhaps two and one-half times as quickly as the core may be assumed to rotate. Their velocity is many times as much per hour as the equatorial velocity of the core probably is. Gravitational computations and logic suggest that the clouds are not continuous in depth clear to the core. A hiatus is indicated between their innermost layers and the surface of the core. This probability is supported by ratios of weight to bulk and by ratio of density of outermost clouds to the core, assuming density of the core to approximate that of the Earth. It seems probable that the lowest layers of the clouds are thousands of miles above the core.

It cannot be doubted that the clouds revolve in independent orbits around the core, kept aloft not by heat of the core, but by centrifugal force generated by their tremendous velocities. Because of similar determinable characteristics the same con-

clusion can be reached with certainty in the case of Saturn and is suggested as to Uranus and Neptune.

We know that the clouds are composed of different minerals. They even have different colors. Although spectroscopic determination is limited because the clouds are not self-luminous, astronomers believe that they have identified water and ammonia in them. It certainly seems logical to assume that they also contain other mineral compounds and elements found on Earth. Because of their visible turbulence and variant rotational periods, we know that their components necessarily must be gaseous, liquified and/or solidified discrete particles. In the case of Venus, the enshrouding envelope is not striated. It is so uniformly homogeneous and colorless that even the period of its rotation cannot be definitely determined. Notwithstanding some conjectures to the contrary, it seems reasonable to suspect that the clouds of Venus may be predominantly aqueous. In another respect, as we shall see, the envelope of Venus possesses implications which differ from those of the four superior planets mentioned.

Three Basic Assumptions

Suggested and supported by the foregoing visible conditions which exist on four of the superior planets, a logical theory of how Earth evolved comes clearly to mind. The theory is based upon three assumptions.

(1) The first assumption is that far, far back in its early formative past, the Earth had evolved to a stage where it consisted of a dense, but molten, intensely hot inner core, surrounded by an envelope of matter not yet incorporated therein; that the surrounding envelope consisted of gasses, volatilized, liquified and/or solidified, separated particles of mineral and metallic elements and compounds; that these materials had been previously formed in the crucibles of intense formative heat by nuclear, atomic and molecular fusion and chemical reactions; that they had been driven far aloft and were pre-

vented from gravitating to the core by the repellent force of the intense heat. For want of a better term we will call this unincorporated envelope of matter the primordial atmosphere.

For our present purpose we need not go back to the much earlier period in Earth's past when, as would seem logical, all terrestrial matter most probably was incandescent and completely gaseous, as is now obviously the case with the sun; nor is it for us here to try to solve what is probably an unsolvable riddle, to wit: how and from what kind, form and shape of original substance the solar system originated. We will begin our speculations at a much later stage of evolution, the time after contraction had progressed until a more or less solid nucleus had formed—a nucleus or core still intensely hot and surrounded, as said, by an atmospheric envelope of unincorporated mineral matter.

The foregoing and first of our assumptions constitutes the very foundation of the theory hereinafter to be expounded. If the assumption can be proven false, the whole theory collapses. The author does not believe the assumption does violence to generally accepted, current beliefs. That not only the Earth, but all planets, were once incandescent and molten is firmly supported by logic and by so much corroborative evidence that it seems scarcely possible seriously to question the truth of such an assumption; and almost nobody ever has questioned it. Although we may not comprehend the true cause of the heat, we recognize the logic and the evidence of its former existence.

Granting that the Earth was once igneous, it must follow that all of the water as well as most, if not all, of the volatile and less refractory mineral and metallic elements and chemical compounds in the present crust must have been at one time vaporized and therefore expelled and repelled from the core by the energy of intense heat and, consequently, suspended in space above. As and when the igneous core lost heat, the suspended vapors must have condensed into solids or liquids, according to their natures, and at some stage of Earth's evolution must have constituted a primordial atmosphere such as envisioned in the above assumption.

(2) The second assumption is that the entire mass of terrestrial material, including both the core and all matter not yet incorporated therein, was rotating. Why, we do not know; but every body in the solar system and probably every celestial body throughout the universe is rotating. Therefore, it surely is not illogical to assume that Earth's primordial atmosphere also rotated.

(3) The third assumption is that at least a considerable part of the primordial atmosphere either possessed originally or had acquired, before the igneous core cooled down, sufficient rotational velocity so that its centrifugal force balanced or exceeded gravitational attraction and therefore could not and did not descend to the core immediately after heat had ceased to repel it. Whether a unit of this moving matter were a molecule of water or a massive boulder, it possessed just so much kinetic energy, which necessarily had to be reduced and counteracted by forces of gravity working against it before it could descend. Therefore, deceleration and declination must have been slow, requiring probably the lapse of eons.

Planets Support Assumptions

To support the third assumption we have amazingly convincing, and plainly visible testimony. Jupiter, Saturn, Uranus and Neptune, albeit they have unquestionably long since lost all or most of their earlier inherent heat, are still surrounded and obscured by envelopes of vaporized, liquified and/or solidified discrete particles of mineral compounds and elements not yet incorporated in their cores. It certainly is logical to believe that the mineral matter in these envelopes has never been a part of the solid cores of the planets. The atmospheres continue to revolve around the cores due to momentum which gravity only can overcome. That deceleration is occurring very slowly is clearly evident; but that the materials under universal law must descend in due time is indisputable.

That water in some form constitutes a prominent part of the rings and clouds surrounding those planets seems too logical

to be doubted. That the clouds also contain other volatile elements and compounds found on Earth surely cannot be questioned. It follows, then, that they contain silicon, calcium, sulphur, sodium, chlorine, potassium, lead, gold, silver, iron and other components in some form and in greater or lesser amounts. They must contain carbon in various forms and compounds. What product has Nature produced which could substitute for carbon in Saturn's "dusky" ring or in the black portions of Jupiter's envelope?

Smoke rising from the stacks of every smelter and steel mill attests the power of even puny fires in man-made furnaces to vaporize and hurl aloft carbon, sulphur, lead, gold, silver and other substances. How vastly more potent must have been the incandescent fires of formative eras!

Obviously the shrouded planetary cores are not incandescent, i.e., self-luminous; hence it cannot be heat which is keeping their atmospheric minerals suspended. We know that the latter are revolving around the cores at great velocities. Therefore, under physical law, it can be only centrifugal force which is preventing descent. They could never have been part of the solidified planetary cores, for, had they once gravitated to the cores due to absence of repelling heat, there could have been no force capable of vaporizing them again and hurling them aloft. Hence they must be primordial. But because all those substances must in time descend, can it be doubted that they will some day constitute portions of super crusts of those planets?

No physicist will deny that if Earth's core was once an igneous, molten mass, all water now upon and within it, also other volatile and less refractory minerals, were vaporized and held away by the repellent energy of heat. No physicist will question the assertion that the vapors aloft must have been hurled into rotary motion in harmony with the same forces which gave rotary motion to the core. Since we can see four other planets covered today with clouds of aqueous and other mineral matter revolving at velocities which prevent descent, can we not conclude with confidence that Earth's primordial

atmospheric matter likewise did not all descend at one time or as soon as heat ceased to repel it?

Formation of Rings

Having propounded the hypothesis that long after Earth's core had cooled an envelope of aqueous particles, mingled with other mineral matter now comprising its crust, continued to revolve around it in space above, we are confronted with the question of how the minerals in that primordial atmosphere behaved and eventually descended to Earth's core. Although all our speculations in this regard may be completely in error, the fact will still remain that all primordial atmospheric matter *has* descended and *has* become part of Earth's core and crust. Of this there can be no doubt. Let us not rule out the probability that some atmospheric matter may have escaped completely from Earth's gravitational control, as will be mentioned later.

In attempting to develop a logical theory of what happened, we encounter many indeterminable questions. How large was the mass of unincorporated matter? What was its shape? How fast was it rotating? Was it rotating independently of the core? Were all its parts rotating at the same velocity, etc.? Doubtlessly, all or most of such characteristics differed at every stage of evolution. However, in any event and no matter what geological era we contemplate, either ancient or recent, we must resort to conjecture, bolstered nevertheless by certain laws, by logic and by visible evidence.

It seems logical to assume that as and when volatile materials were being formed and expelled by heat from the igneous core, they were repelled in every direction, hence originally were of spherical shape, surrounding the core. Granting that the core and the surrounding gasses were rotating, we can understand that at the poles of the axis of rotation centrifugal force was zero, leaving heat as the only repellent force.

In proportion to recession from the poles toward the equator, centrifugal force, acting always at right angles to the axis of

rotation, would increase to a maximum at the equator. This would irresistably impel materials in the direction of the equator, and alter the original spherical form of the mass into an increasingly oblatoidal, elliptical shape until all the lingering atmospheric material eventually would become but a thin disc in the plane of the equator. For amazing evidence that the foregoing analysis of physical law may be correct, one need only take his telescope and look at Saturn. There for all to see is a remarkable, perfect example of what eventuates as the result of the forces we have just considered.

Now it would seem illogical to doubt that all the planets have evolved in the same way. They all belong to the same system, are made of the same materials and are subject to the same laws. It would be illogical to assume that, of all the planets, by some set of peculiar circumstances not common to other planets, Saturn alone developed a system of rings. Hence reason would seem to justify us in concluding with considerable confidence that at some time in the past the Earth was surrounded by rings of matter just as is Saturn today.

Of course we cannot ascertain how long it took Earth's atmospheric mass to change from a probably spherical shape to the eventual disc form. Presumably it took eons. Nor can we tell how long it took the core to cool down. Conceivably, however, and probably, cooling eventuated first. Hence if any atmospheric matter still lingered near the poles, such matter, together with any other which lacked sufficient rotational velocity to overcome gravity, descended after heat ceased to repel it. Thus, Earth's first shallow oceans were formed and the lowermost layers of her stratified crust were laid directly upon her Archean, igneous sills. Any remaining atmospheric matter having sufficient velocity to offset gravity must have remained aloft, no doubt until some of it at least reached disc shape in the plane of the equator.

If it is true that all planets once possessed ring systems, it follows that the clouds of mineral matter which still surround Jupiter, Uranus and Neptune, also those beneath Saturn's rings, must consist of former ring matter in later stages of declination.

However, the idea that, in addition to Saturn, other planets had rings, can be discarded without in the least weakening the conception that the present cloudy shrouds of four superior planets are primordial minerals which have not yet descended to the cores. Neither would it lessen the probability that the Earth once was surrounded by a shroud like five other planets are.

Velocities Governed by Law

Assuming that Earth did once have rings, let us now try to imagine what happened to them and incidentally what will in time happen to the rings of Saturn. Of course we do not know how fast the rings were rotating; neither do we know the force of gravity at the time. Possibly it may not have been much less than it is now, inasmuch as the total terrestrial mass was then probably about the same as today. We do know, however, that the orbital radius of any particle, whether it were a molecule of water or a ten-ton boulder, would be determined by its velocity. Assuming that gravity were then the same as it is today, we know that matter revolving in the plane of the equator, at a distance of 4,000 miles from the core's center, would require a velocity of approximately 17,500 miles per hour to overcome the pull of gravity and remain aloft. At a distance of 26,000 miles from center, it would need a velocity of only 6,800 miles per hour (effecting revolution in 24 hours); at 100,000 miles from center, the required velocity would be roughly only 3,475 miles per hour. Required speeds at other radii would be proportional.

The velocity of revolution required at any radius to develop centrifugal force exactly equal to gravital force at that radius is known as "orbital speed." Should the velocity of material at a certain radius be decreased in any amount below orbital speed at that radius, the material would decline toward the core. As it thus declined, the difference between its velocity and orbital velocity would progressively increase. Hence its declination would continue at an increasing rate and never stop until the

material reached the core. This would be true unless its velocity on the way down were, in some manner, stepped up to orbital speed.

On the other hand, if the velocity of a particle at any distance from center was greater than orbital speed at that distance, the particle would begin to recede farther from center and, *provided it maintained the same velocity*, would keep on receding until it eventually escaped from Earth's gravitational control. This would be true for the reason that the force of gravity acting upon it would diminish as the distance of the particle from center increased. That some ring matter did so escape seems entirely possible. We know that space within the Sun's control contains vast numbers of meteoric particles of every size. These, at some time, conceivably, could have been parts of planetary primordial atmospheres.

Light Minerals Driven Highest

It seems reasonable to assume that when the many volatile elements and compounds were formed, they must have been driven aloft by the intense heat to distances more or less proportional to their specific gravities and relative volatilities. Water, being comparatively light and highly volatile, would be repelled to greater heights, whereas iron and other heavier and more refractory materials would be repelled to lesser heights.

If the resulting relative distances from center of the different materials were retained as the materials gravitated toward the equatorial plane, the outer portions of the ring system would be composed predominantly of water, carbon and other light elements and compounds. The inner portions would consist largely of heavy metals and more refractory minerals. As a result, more or less separate rings, with spaces between, would tend to form. The rings of Saturn clearly illustrate the idea.

The velocities which we have postulated would have been necessary at various radii to prevent the immediate descent of the suspended material after heat ceased to repel it, do not seem at all excessive as compared to the measurable speeds of

rotating atmospheres surrounding other planets. Neither the mentioned radius of 26,000 miles, which might possibly have been the radius of the innermost part of the disc material, nor a radius of 100,000 miles, which might be assumed for the outermost portion, would seem at all fantastic, judging by the example of Saturn. However, either radius, also the velocity of rotation, could well have been greatly different without lessening the logic of the theory, which is all that concerns us. Furthermore, all the factors mentioned undoubtedly changed as evolution progressed.

Declination of Rings

If, then, all atmospheric matter in the original spherical mass which had not yet descended to Earth's core finally reached the equatorial plane and gravitated into disc form like the rings of Saturn, how did these materials thereafter return to Earth? It is obvious that they could not return in any event or manner unless and until their velocities were reduced below orbital speeds. We know that there were forces in existence which would have gradually so reduced them. Certainly if the Moon were then in existence, revolving at approximately its present speed, it would have created tides in the primordial atmosphere to pull backward, thus retarding rotational velocity. We can have no doubt whatever that the Moon did exist and did revolve around Earth certainly at the very recent times, geologically speaking, when the known ice ages occurred. We can thus confidently conclude that Earth's revolving rings did gradually lose velocity and hence did decline toward the core. Let us try to visualize what would then occur.

There can be no doubt that since life first appeared Earth has had an air atmosphere very similar to the present one. As and when a declining increment of the ring matter came, in due time, into contact with the outer reaches of Earth's true atmosphere—the air envelope—which would in a measure resist its declination and also quicken the reduction of its speed, it would tend to widen from its thin disc form and spread each

way toward the poles, forming two bands or belts, one on each side of the equator. These bands would gradually gravitate spirally toward the poles in the exact reverse manner, due to their declining speed, from the way we saw that atmospheric matter in the former spherical shape was impelled toward the equator. Inasmuch as the various rings aloft were to some extent separated from each other, their increments would reach Earth's air envelope at separated times, each to divide and form two additional bands to gravitate poleward. That the latter process was very slow, we have ample confirmation in the examples of our sister planets.

As and when Earth's bands moved poleward and their velocities decreased, eventually the materials in them necessarily fell. Inasmuch as centrifugal force decreased and gravital force increased toward the poles, the materials in the bands would tend to fall earlier and more largely toward the poles than toward the equator. Implications of this thought are manifested in the distribution of certain metals found on Earth, of coal (to be discussed hereafter) and of other minerals which are found more plentifully in upper latitudes than in equatorial regions.

Sequence of Descent Uncertain

Of course it will be impossible ever to ascertain how and in what sequence the numerous components of the primitive atmosphere declined and eventually reached Earth's surface. It would seem that minerals in the outermost rings, already moving at the slowest velocities and affected most strongly by lunar gravity, because closest to the Moon, would decelerate soonest to less than orbital speed, hence would decline into and through faster moving matter below. Collisions, intimate mixing and great turbulence would result. According to this reasoning, lighter elements and compounds, being in outermost segments, should have descended ahead of heavier and more refractory minerals in lower segments. Yet heavy metals and other minerals appear to have reached Earth's surface early, for they predomi-

nate in lower crustal strata. Did they, then, perhaps originally lack orbital velocity so that they descended quickly after heat ceased to repel them and before they gravitated into disc form? We have reasoned that water predominated in outermost segments of the ring system. Is it possible that heavier minerals in lower rings were washed down, so to speak, by water descending from higher segments?

What happened after ring matter declined and spread into blanket form is also indeterminable. Jupiter's cloudy shroud shows terrific turbulence. Sudden changes occur in arrangement and distribution of the various components. Even decided variations in revolution of parts of the clouds are noticeable. Sometimes one portion will either gain upon or lose to another portion, possibly indicating collisions as suggested above.

At any rate, such erratic behavior shows how futile would be any attempt to determine accurately how primitive atmospheric minerals eventually descended to Earth's surface. We can be certain, however, that gravital forces made descent inevitable. When we look at Jupiter and other major planets we cannot doubt that in due time their skies too will be cleared, just as ours have been. Their more slowly revolving satellites, which pull back against the faster revolving matter in their shrouds, inevitably must and will slow down those atmospheric minerals until eventually they must fall to the cores. It cannot be otherwise.

The reader should bear in mind that in the foregoing studies and speculations we have been primarily concerned with terrestrial conditions which existed at the very recent times when ice ages occurred. Our conjectures about conditions which may have existed far, far back in very, very early formative periods of Earth's history, were occasioned solely by our attempt to account for conditions existing at this very hour on certain other planets and which we can see with our telescopes. We have pictured a mechanism of physical forces which obliged primitive atmospheric and other volatile mineral compounds and elements to stay aloft for eons, but which caused them

eventually to descend in increments, repeated throughout geological time, to accumulate oceans and contribute to the layered rocks which form Earth's supercrust and hide her igneous sills.

Planets Corroborate Deductions

Granting errors, therefore, in the foregoing deductions relative to the formation and subsequent behavior of the rings and enveloping clouds of the primordial atmosphere, the undeniable fact remains that the planets supply amazing, visible, corroborative testimony as to the truth of the salient features. No one, unless motivated solely by refusal to abandon old notions, can lightly dismiss this theory. Should he seek to disprove it, he must first dispose of the corroborative testimony of the planets. There they float in the heavens for all to observe.

We can see in the rings of Saturn an exact exemplification of our imagined Earth rings. We know that there are several rings separated from each other. With our improved instruments we can now see more rings than were visible to observers in the past. Perhaps there are more than we now see. We know that Saturn's rings are not solid. We know that they are composed of discrete particles of condensed, liquified or solidified minerals. We know that they contain different minerals. It is logical to believe that these materials have never been a part of Saturn's inner core. Actual measurements, in addition to laws of motion, tell us that they revolve at different velocities, the outermost portions at lesser velocities than the innermost. It is clearly evident that they are prevented from immediately gravitating to Saturn's core by the centrifugal forces which their velocities generate. That the rings will, however, lose velocity and in some manner will approach the planet's core and eventually fall there-to is unquestionable.

Exemplifying what we have assumed to be later stages in the decline of primordial atmospheric minerals toward the cores of planets, we see, in exact conformance with our hypothesis, mottled, tenuous envelopes surrounding and obscuring the cores of Neptune, Uranus, Saturn and Jupiter. On at least three of

those planets we see bands on each side of the equators, divided by rifts or gaps between. As said before, these bands, at least in the case of Jupiter, which is near enough for visual confirmation, are of different appearances, even colors, and undoubtedly of different chemical composition. Although they entirely obscure the cores of the planets, they rotate at differing velocities, more slowly toward the poles than near the equators. Hence we know that they rotate independently of each other and therefore independently of the cores.

We know that the shrouds which obscure the cores of Saturn and Jupiter revolve in about ten hours. All the planets are members of the same system and are subject to identical laws of gravity and motion. Saturn's mass is nearly 95 times as great and its bulk more than 700 times as large as the Earth. Jupiter is more than 300 times as heavy and some 1,300 times as bulky as the Earth. It would seem highly improbable and contrary to law that such immense masses would rotate two and one half times as quickly as do the smaller Earth and other inferior planets.

According to this reasoning, we can rather confidently assume that the solid cores of Saturn and Jupiter, undoubtedly larger than the inferior planets, surely rotate no faster than once in twenty-four hours and very possibly even more slowly. In other words the minerals in their shrouds are revolving around the cores as independent satellites with velocities which prevent them from descending immediately to the cores. The same thing surely must be true also of Neptune and Uranus.

In the case of Venus it would seem more logical to conclude that its colorless shroud, being very much less bulky and hugging close to the planet's core, is rotating either at orbital speed or with the core, like Earth's air envelope is doing. If it is revolving at orbital speed, independently of the core, it may continue to do so forever inasmuch as Venus has no satellite, which, revolving more slowly than the core rotates, would pull back against the shroud and reduce the revolutional velocity of the latter until it would eventually descend to the core.

In these tenuous envelopes surrounding and obscuring the

cores of the planets we perceive what would seem to be unquestionable examples of primordial aqueous and other mineral matter gradually approaching ultimate incorporation into the crusts of the planets. We see this material losing momentum and revolving more slowly toward the poles than at the equators. Hence it must be gravitating from equatorial regions toward the poles, indicating that it once must have been incorporated in equatorial ring systems. Possibly we even see it falling to the cores of the planets, as evidenced by the flattened, depressed polar portions of the tenuous envelopes. More conclusive proof to substantiate our deductions can scarcely be imagined.

Requirements for Refutation

Exception to the foregoing conclusions would be of little force and effect if based merely upon the statement that "the conclusions have not been proved." Obviously nothing can be "proved" about such abstruse subjects. Acceptable conclusions can be reached only by weighing more logical interpretations of visible evidence against less logical and less acceptable interpretations. Accordingly, anyone who would refute the above conclusions must produce logical reasons for believing:

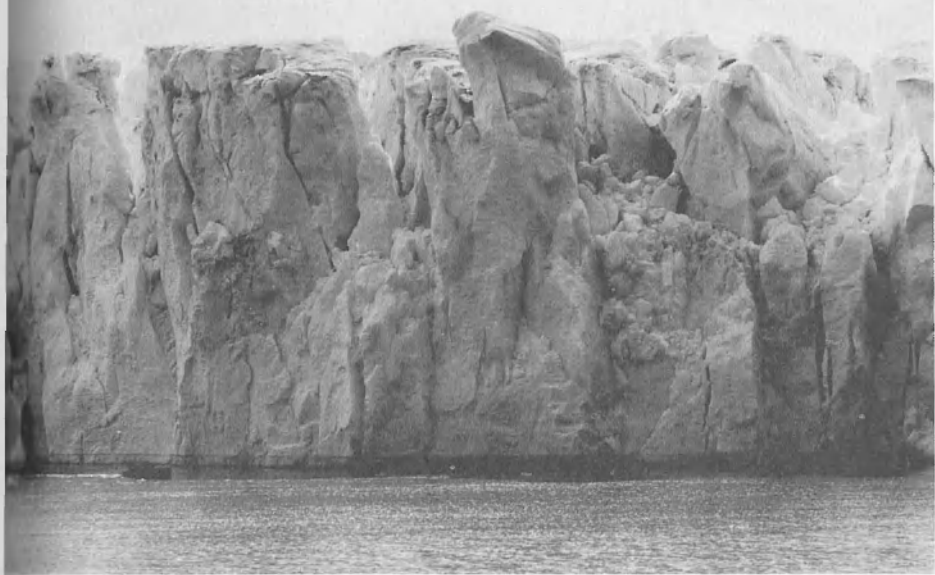
1. That Jupiter, Saturn, Uranus and Neptune have not lost substantially all of their internal, formative heat.

2. That Saturn's rings are not remnants of primordial atmospheric mineral matter revolving at velocities which prevent their immediate decline to the planet's core.

3. That the mottled, banded, obscuring clouds surrounding Jupiter, Saturn, Neptune and Uranus also are not primordial mineral matter, exemplifying declination at a later stage of evolution than the rings of Saturn.

4. That it is erroneous to assume that the minerals in the clouds and rings have never been part of the solidified cores of the planets.

5. That the rings and clouds are not losing velocity due to known forces and will not eventually descend and be incorporated in the cores of the planets.

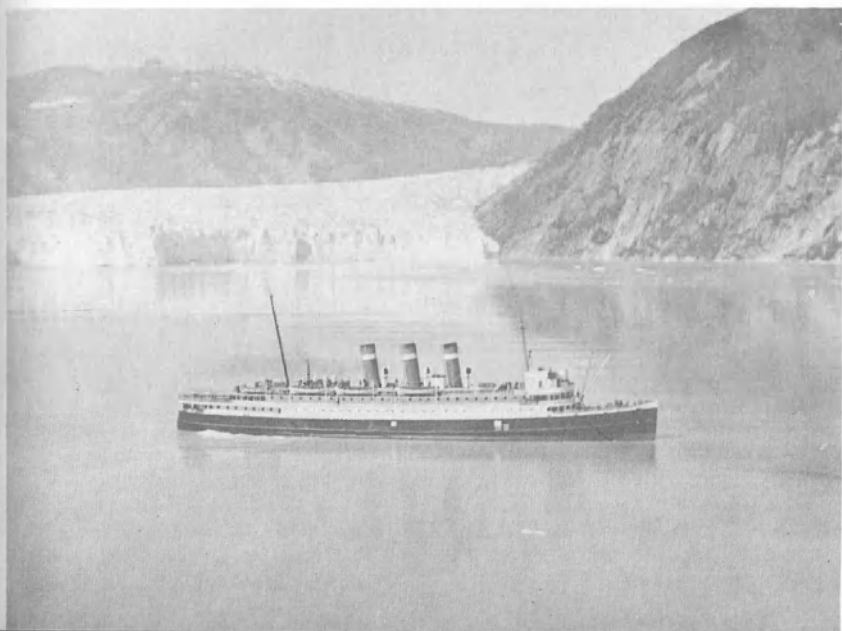


Canadian National Railways

Close-up of terminal cliff of Taku Glacier, coast of southeastern Alaska. Height of cliff more than 250 feet. Note launch near glacier, lower left.

Canadian National Railways

Distant view of Taku Glacier, which discharges into Taku Inlet, southeastern Alaska.



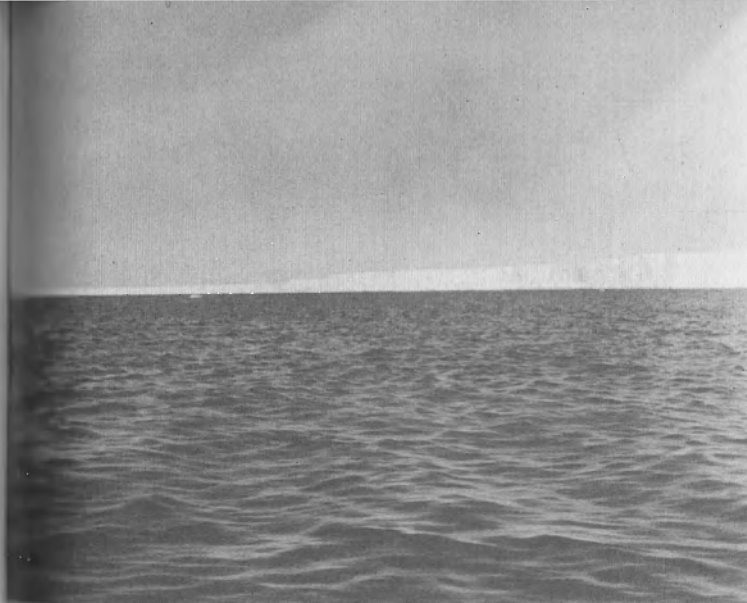


Canadian National Railway

Melt-water stream flowing from beneath Mendenhall Glacier, southeastern Alaska. Tiny human figures on black hillside silhouetted against the ice at upper extreme right convey an idea of scale of glacier.

U.S. Navy

U.S.S. Joseph E. Merrell moored at a low point in Ross Ice Shelf, Kainan Bay, Antarctica, Operation Deepfreeze. (Page 29.)



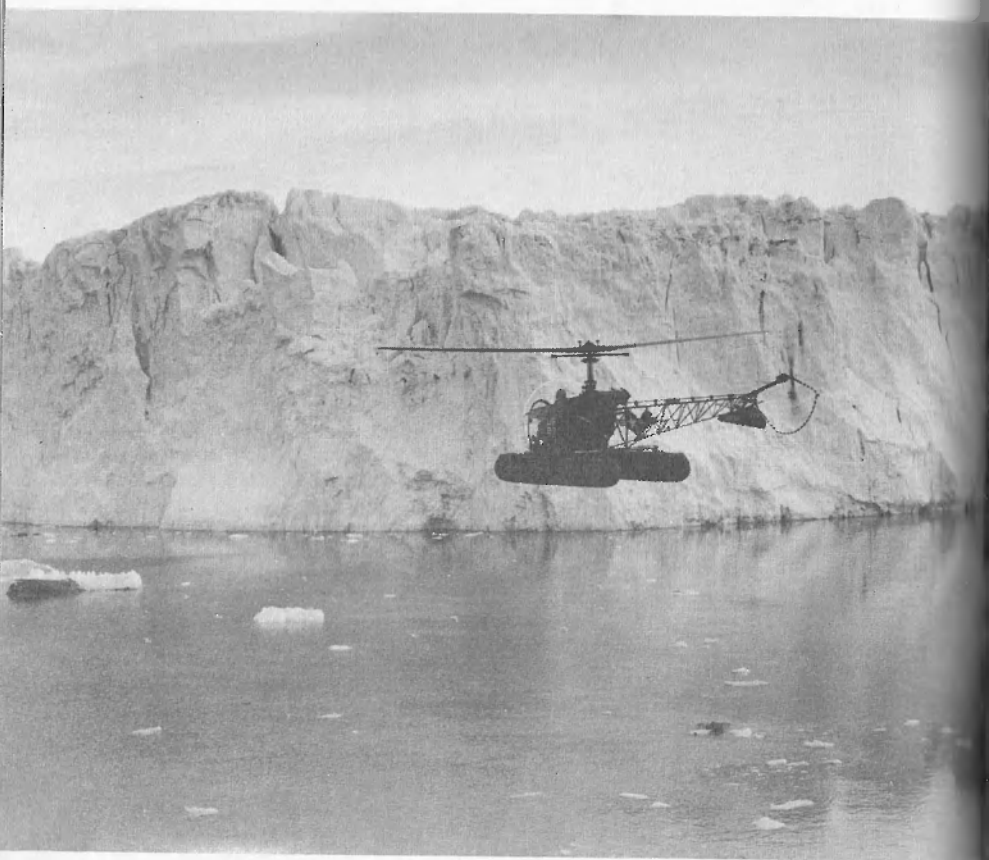
U.S. Navy

Distant view of a segment of the Ross Ice Barrier, Antarctica. The ice cliff extends continuously for more than 500 miles from east of Little America west to McMurdo Sound. It varies slightly in height from about 50 to 200 feet. As the ice is afloat, its thickness must approach 1500 feet in places. (Page 29.)

U.S. Navy

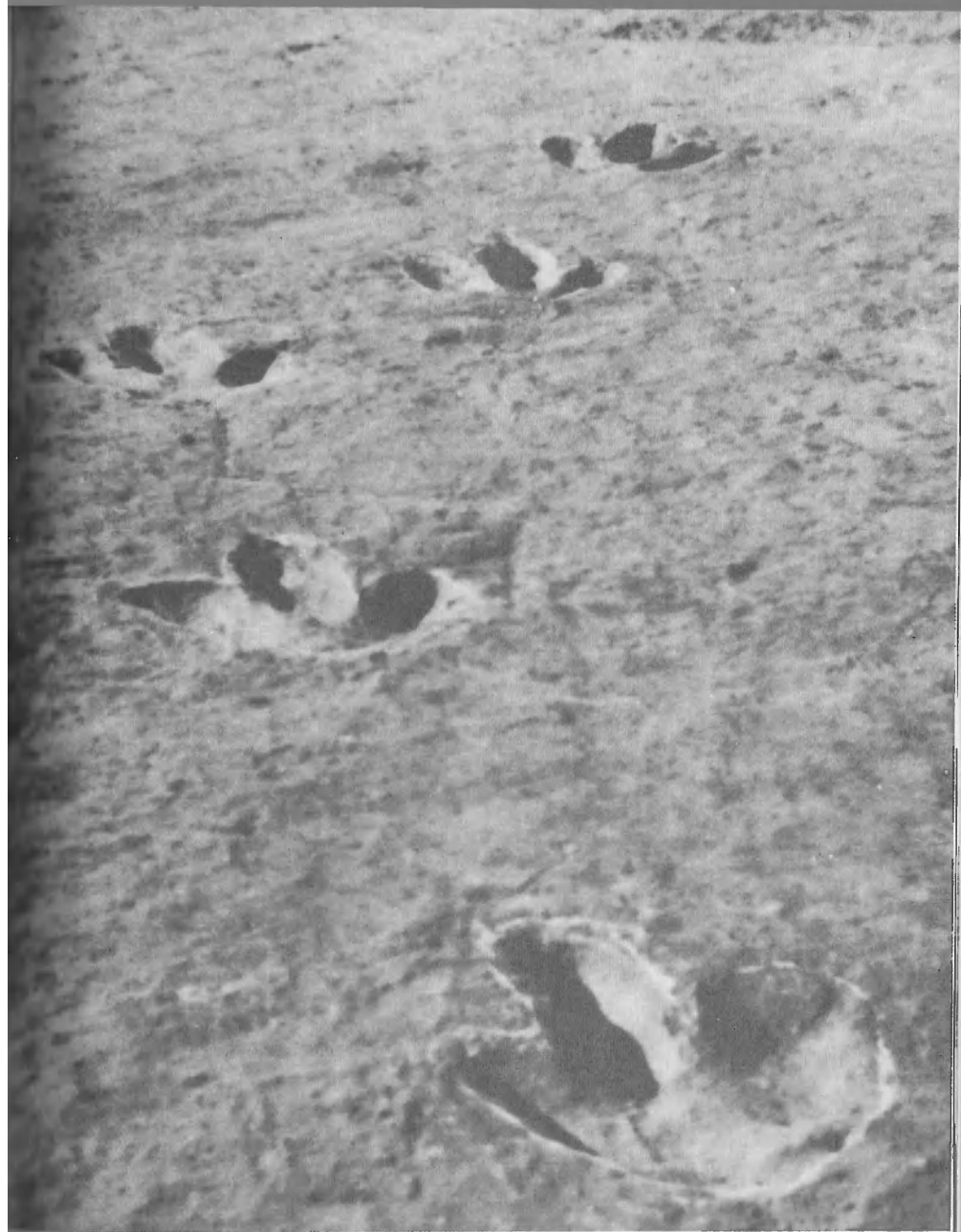
One of hundreds of Greenland glaciers—west coast near Thule. Such glaciers are fed from the high inland ice sheet and descend through mountain valleys to salt water on both east and west coasts.





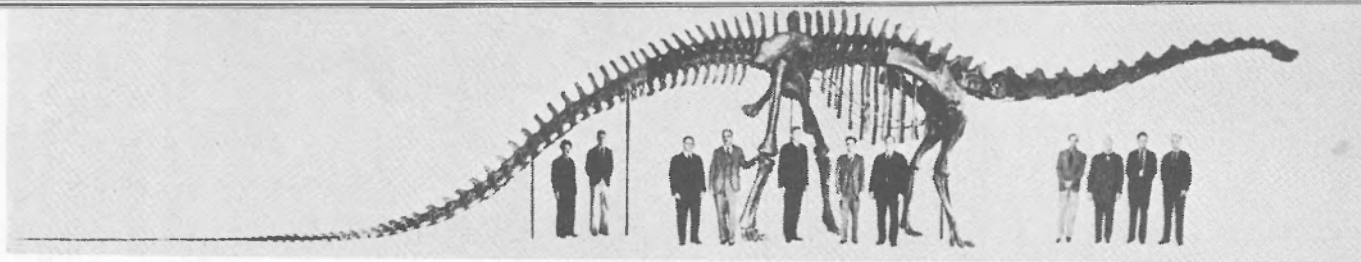
U.S. Navy

Navy helicopter passing a Greenland glacier en route to Thule. The terminal cliff of one such glacier is 60 miles wide and 300 feet high. From the cliffs of scores of these glaciers hundreds of huge bergs annually are calved into Davis Strait.



National Park Service

"Footprints in the sands of time" turned to stone. A dinosaur lumbered across this spot in the Triassic period 175 million years ago. Thereafter sediments 3,000 feet deep buried the spot. Other fossils of land animals in strata both above and below these prints prove that the area was not below sea level while much of the sediment was being deposited. (Page 106.)

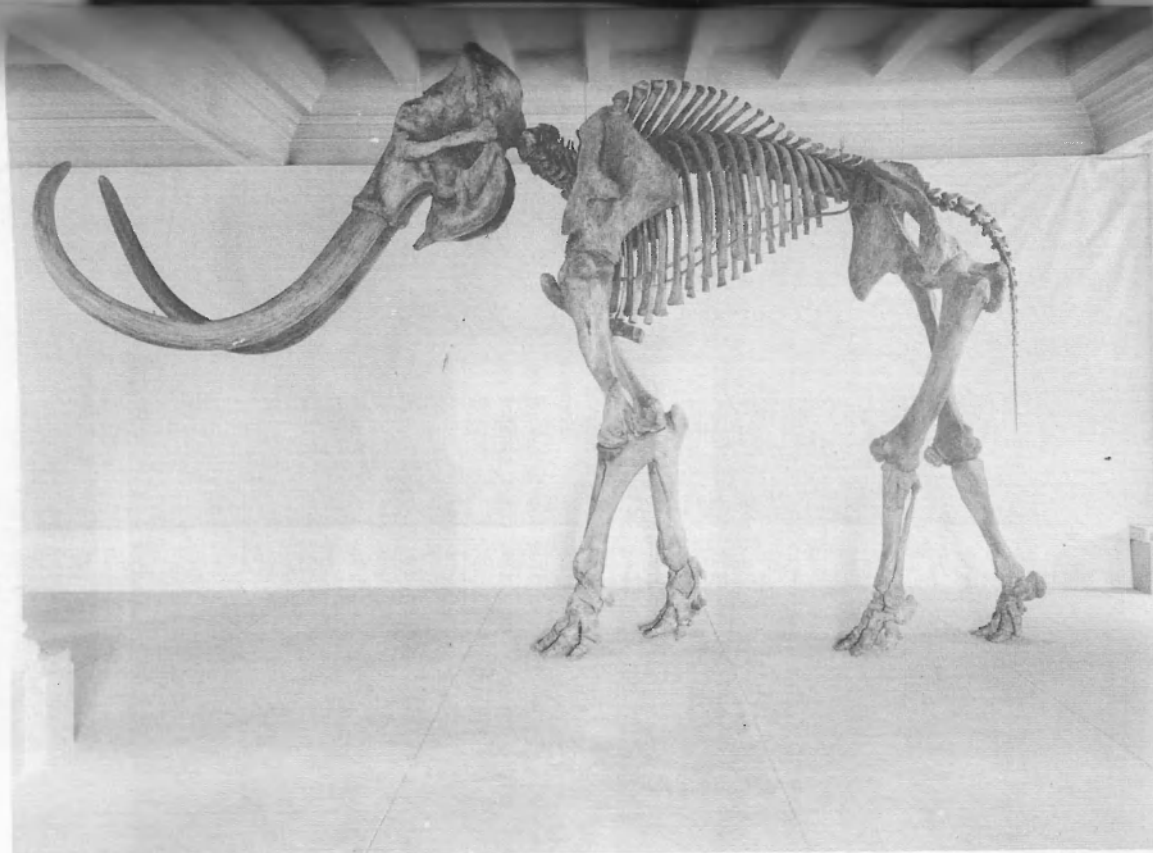
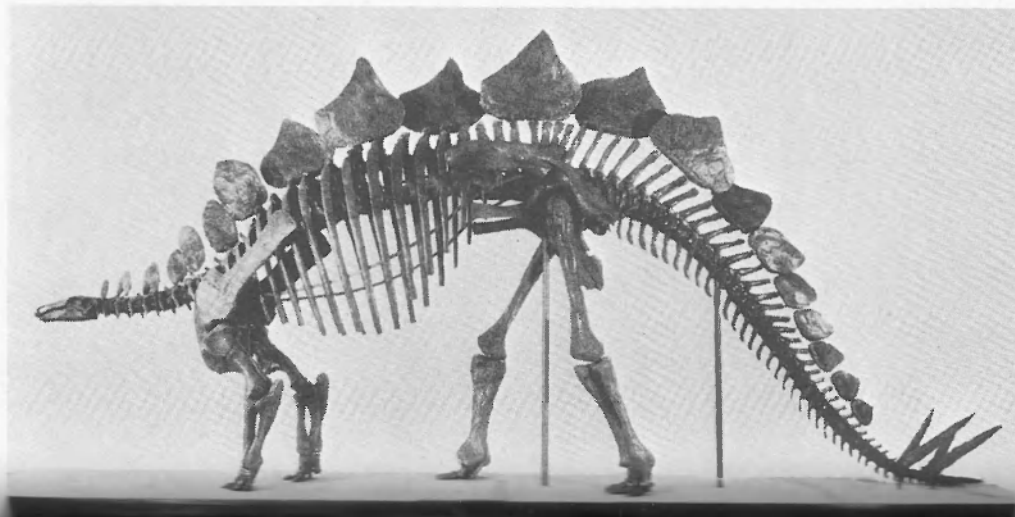


Denver Museum of Natural History

Dinosaur seventy-five and one-half feet long. Such huge Jurassic reptiles disappeared completely and suddenly. Obviously the cause must have been catastrophic. (Page 46.)

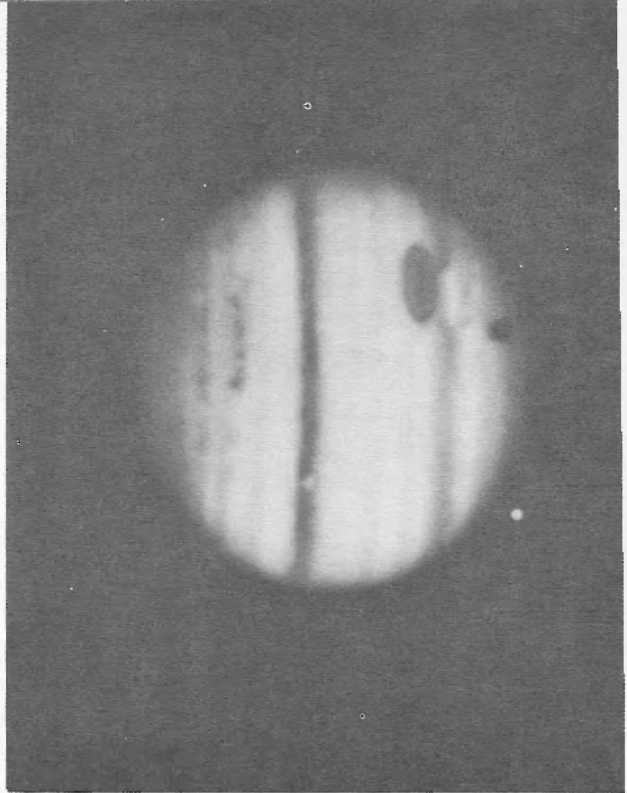
Denver Museum of Natural History

A Jurassic dinosaur (*Stegosaurus Stenops*) 20 feet long—a vegetarian reptile with virtually no brain at all. (Page 46.)



Denver Museum of Natural History

Pleistocene mammoth ten feet tall. All species of vegetarian proboscideans except Indian and African elephants disappeared abruptly in Pleistocene time. Complete bodies of mammoths have frequently been found frozen in glacial ice in Siberia and Alaska. (Page 48.)

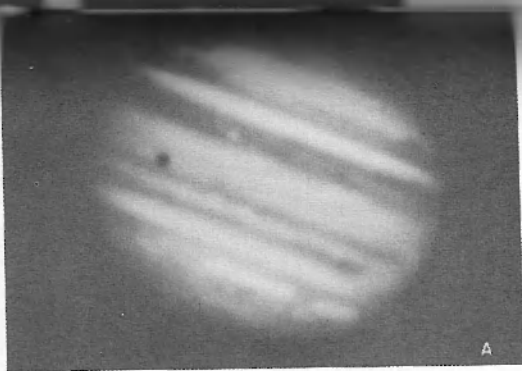
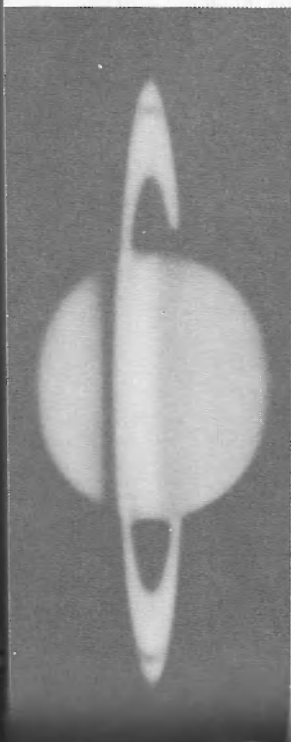
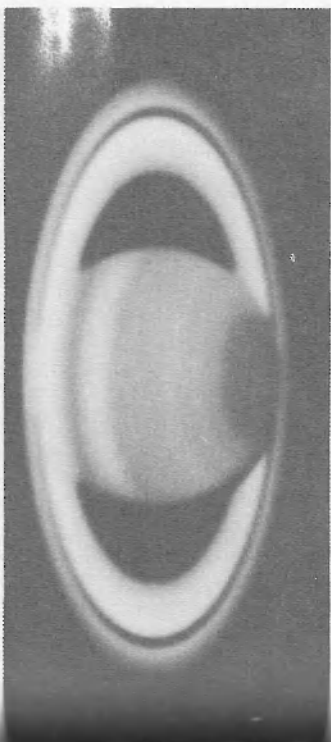


Palomar Observatory

Jupiter in blue light, distinctly showing oval-shaped red spot. Satellite Ganymede, top right, just outside disk; its shadow on disk above red spot. (Page 71.)

Palomar and Mt. Wilson Observatories

Upper exposure: Saturn with rings most nearly broadside. Striations of shroud plainly visible. *Lower exposure:* In blue light, rings almost edge-on. Oblateness of shroud very noticeable. (Page 82.)

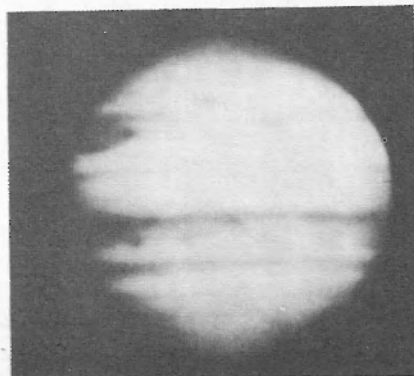


Palomar and Mt. Wilson Observatories

Jupiter: A shows shadow of satellite on disk. B, taken 50 minutes later, shows both satellite and shadow. (Page 83.)

Yerkes Observatory

Two exposures of Jupiter taken 23 minutes apart. Rotation plainly evident; also rapid changes in clouds. Large red spot upper left. (Page 70.)





Denver Museum of Natural History
 Sandstone slab from Agate Quarry, Nebraska, containing mass of rhinoceros bones, washed together by a catastrophic Tertiary flood. Indicates dense animal population. (Page 95.)

Texas Gulf Sulphur Co.
 Elemental sulphur stored in vats each 1200 feet long, 180 feet wide, 50 feet high. Each contains about 500,000 long tons of pure sulphur. (Page 103.)



Denver Museum of Natural History

Dinosaur tracks in sedimentary rocks of hog-back west of Denver. (Page 106.)

U.S. Geological Survey

Fossilized dinosaur tracks in Triassic sandstone, Navajo Canyon, Coconino County, Arizona. (Page 106.)





National Park Service
Prehistoric animal tracks,
Grand Canyon National Park,
(Page 106.)

U.S. Geological Survey
Grinnell and Gem Glaciers and Gar-
den Wall, Glacier National Park,
Montana. (Page 111.)



U.S. Geological Survey
Grand Canyon of the Colorado River.
Rocks of V-shaped bottom gorge are
igneous; all rocks above are sedi-
mentary. (Page 113.)



U.S. Geological Survey

"Granite Gorge" and Colorado River at bottom of Grand Canyon. All strata above the crystalline, igneous rock of this gorge are layered, sedimentary rocks. (Page 113.)

Union Pacific Railroad

Great White Throne, Zion Canyon, from Scouts Lookout. Height 3000 feet. Upper half white, lower half brilliant red sandstone. (Page 113.)





Union Pacific Railroad
Grand Canyon from north rim. Note horizontalism of strata. Silhouette of San Francisco Mountain (volcanic) on horizon at right. (Page 124.)

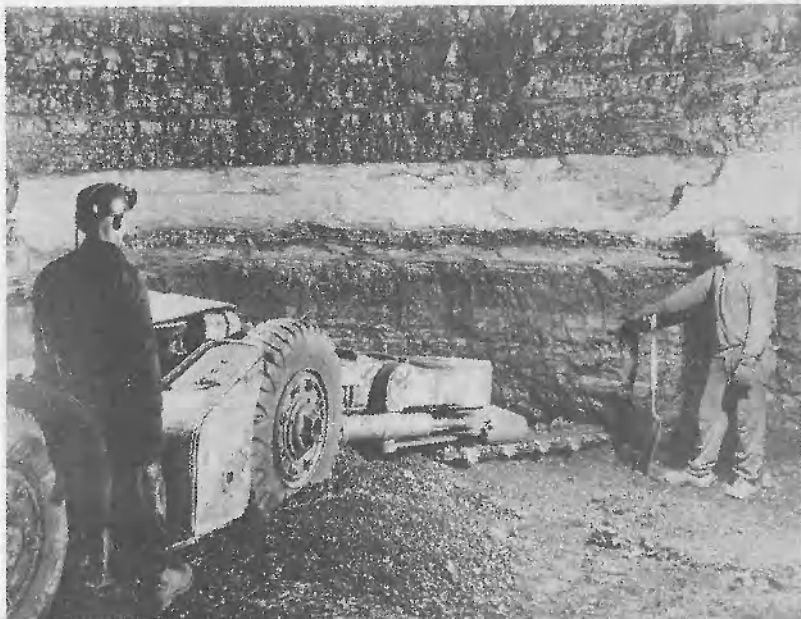


U.S. Geological Survey

Grand Canyon of the Colorado, showing horizontalism of rock strata. Distant horizon faintly visible at upper right is plateau 2,000 feet higher than rim of canyon. Intervening bench has been lowered 2,000 feet by erosion. (Page 124.)

Joy Manufacturing Co., Pittsburgh

Successive seams of bituminous coal. Lowest seam, 5 feet thick, separated from a 6-inch seam above by a thin stratum of rock. The 6-inch seam of coal in turn is separated from a thick seam above by a 2-foot stratum of rock. Undercutting machine at work on the coal face. (Page 129.)





Yerkes Observatory

Brooks Comet. *Left:* Exposure before tail had formed. *Right:* Exposure when tail of luminous vapors had grown to length of about 35 million miles. (Page 135.)

6. That there is no logic in concluding that Earth evolved in the same way as the foregoing planets appear to be evolving.

In the absence of such controverting evidence, it would seem that we are justified in concluding that, geologically speaking, at a recent period in Earth's history much of the mineral matter now incorporated in its stratified crust, as well as a large amount of the water now in its hydrosphere, were still suspended in space above, earlier perhaps in the form of disc-shaped rings and later as overclouding canopies or envelopes extending at times from equator to poles like the shrouds of Neptune, Uranus, Saturn and Jupiter.

Water Descended in Increments

In contemplating the probable composition of Earth's primordial atmosphere, we reasoned that water was a prominent constituent. We reasoned that in all probability it was volatilized first and repelled farthest from the molten core. Conceivably, then, it could have been the last or among the last components to return to Earth. There can be no doubt that evidence supports the latter supposition.

We reasoned that inasmuch as primordial atmospheric matter was rapidly revolving, it would lose momentum and could descend only slowly after heat ceased to repel it. With our telescopes we see on other planets conditions which confirm this reasoning. According to our theory, the atmospheric minerals were more or less separated and segregated into different rings and bands which would gravitate and descend to the core at separate times. Hence we concluded that waters now on and within Earth's core could not and did not all descend at one time, but, on the contrary, accumulated from increments which descended at widely separated, erratic intervals. This conclusion is definitely supported by physical laws of motion, by the testimony of other planets and by evidence plainly visible on Earth. The realization that the hydrosphere has thus been increased within geological times clearly solves many, many otherwise

inexplicable mysteries which have baffled scientists since time immemorial.

If, then, primitive waters descended in increments, it requires little imagination to perceive that at times they descended in sudden, cataclysmic deluges perhaps of rain in or near tropical zones and of ice and snow in and near polar regions. If a fall happened to occur in winter in an area only thirty or forty degrees from the equator, it would very probably be in the form of ice or snow; whereas if the fall occurred in summer, even as far north as Siberia or Alaska, it could conceivably be in the form of rain. No doubt, variations were localized, regional and erratic. It seems logical that if aqueous vapors at a height of only a few thousand feet can congeal into ice even in midsummer, at heights of hundreds or thousands of miles such congeallation would be inevitable.

The latter thought suggests that probably at least the major percentage of primitive water which descended from the outer reaches of space was frozen—frozen despite the fact that latitudinal variations in climate were then less than at present and even polar climates were then mild. Does not the thought also offer an explanation of the fact that ice sheets were deposited in and near tropical zones? Does it not suggest that frozen moisture falling into the oceans caused sudden and pronounced chilling of the waters, with consequent extinction of some forms of marine life?

True Solution at Last

Now is it at all fanciful to conclude that here, at long last, is the true solution of the age-old mystery of ice ages? This is the first and only theory which is based upon physical laws, with visible exemplifications in the heavens to verify the basic principles; the first theory not evolved out of pure imagination. Is it not, of all theories, the only one which envisions a chain of circumstances and conditions which could produce snowfalls capable of building inconceivably vast continental ice sheets?

It is a rule of scientific research that any theory, to be ten-

able, must be supported not only by sound logic but also by definite visible evidence. Even though there may be good logic in a theory, if observational support is lacking, the theory is repudiated. When a theory is sustained both by sound logic and by liberal visible evidence, its truth is acclaimed. In reviewing the many attempts which have been made to account for glacial episodes and for former lower ocean levels, we found that in all instances either the basic concepts were clearly illogical or observational support was lacking.

The fresh theory herein expounded is predicated upon the scientific fact that neither any degree of cold nor any extreme of heat which could have existed on Earth at the times of glaciation was capable of raising to the skies the incredibly vast amount of water involved in an ice age. The inescapable conclusion is that the water must have been primordial and must have been circling the Earth since it was hurled aloft during formative incandescent eras. This conclusion is not only based upon sound scientific logic but is firmly and decisively supported by observational evidence, both on Earth and in the skies.

Not the least convincing item of supporting logic in the theory is the explanation it gives of how and why ocean level in the past could have been 10,000 or 12,000 feet lower than it is now; also, how ocean waters, amazingly, have been augmented even very recently, geologically speaking, as is so definitely indicated by abundant evidence.

The writer fully realizes that some critics, reluctant to abandon old, sacred teachings, will hesitate to accept this new and unorthodox theory; but if they will entertain it tolerantly while reviewing the studies of Coleman, Wright, Lyell, Croll, Geikie, Kuenan, Zeuner, Flint, Shepard, Daly and countless other geologists, oceanographers and other scientists, they will be amazed at how definitely and convincingly the theory explains many mystifying phenomena which have baffled those eminent gentlemen.

Let us now consider a few of those mysteries.

CHAPTER FOUR

OTHER MYSTERIES SOLVED

Causes of Climatic Changes

IT IS THE CONCENSUS of scientists that all glacial episodes were of short duration; that they were followed by mild climatic conditions; that the latter were the rule throughout interglacial periods. It is the orthodox belief that accumulation of glaciers resulted from slow deterioration of climate. The corollary of that belief is that subsequent disappearance of the glaciers was due to warming up of climate.

As we have noted, a hundred years of study and speculation have failed to produce a tenable reason for deterioration of climate. The true explanation is, as we shall see, that climate did not grow colder *prior* to arrival of the ice; it grew colder *afterward* and *because* of the ice.

In area, the ice sheets aggregated more than one-third of the present total land area of the globe. There can be no doubt that, in addition to what snow and ice fell upon land, great quantities also fell into the oceans. It cannot be doubted that such an inconceivably vast quantity of ice and snow was fully capable of destroying or greatly modifying faunal and floral life forms of land, sea and air. Scientists have made the error of assuming that discernable changes in life forms prove that climate grew colder *before* the arrival of the ice.

Strangely, very little, if any, attempt has been made to explain why climate warmed up after a cold glacial spell. Virtually all efforts have been to find out why climate grew colder. However, as the latter efforts have failed, even after a hundred years of study, it can scarcely be expected that the cause of

subsequent amelioration could have been determined even by an equal amount of study.

A phenomenon even more intriguing than the foregoing is why and how zonal differences in global climates could have been so much less pronounced in past geological periods than they are now. The consensus is that during the greater part of past time, mild, temperate-type climate extended much farther toward both poles than it now does; in fact, that it extended even to within both polar circles. As an example of this belief Barghoorn, speaking of the Carboniferous period, says (paper in Shapley's *Climatic Change*, p. 241):

From the paleontological evidence available, it would appear that there was very slight climatic zonation between high and low latitudes during the major part of the Carboniferous.

Yet scientists are also agreed that climatic temperatures in the torrid zone were not much, if at all, warmer than they are now. Dr. Bell says (*Solar Variations*, p. 132):

It is by no means clear that solar radiation sufficiently intense to keep the poles as warm as they appear to have been at times would not heat the tropics more than observations indicate.

Planets Explain Zonal Uniformity

Astronomers, geophysicists, geologists and other scientists alike, have been quite unable to conceive an explanation of the astonishing uniformity of past climates in all zones of latitude. Actually, of all writers who have commented about the mystery, very few, if any, have made any serious attempt to account for it. Had it but occurred to any one of them to take a good look at Jupiter or Saturn, and reflect upon the implications inherent in conditions plainly visible on those planets, surely he would have conceived the true explanation of why comparative uniformity of zonal climates was the rule throughout most of geological time; why it was broken only at irregular intervals by glacial episodes; and why mildness and uniformity

of climate returned after every glaciation with the exception of the last one. He would have realized that such absence of zonal influence upon climate can never again eventuate.

A thorough study of Jovian or Saturnian conditions would have convinced him that the clouds which obscure those planets can be nothing but tenuous envelopes of discrete aqueous and other mineral particles, revolving quite apart from the cores. This conception would have brought realization that if Earth in the past was similarly blanketed, a hothouse effect would have resulted and climatic temperatures would have been raised and made more uniform in all zones of latitude.

Some theorists, in trying to imagine conditions which would cause lower climatic temperatures, have suggested that excessive volcanic or cosmic dust in the atmosphere would effect such a result. This is contrary both to evidence and logic. Cloudy nights are always warmer than clear nights. The roof of aqueous vapor on a cloudy night retards escape of solar heat. A tenuous mantle of water or mineral matter suspended far above and completely enshrouding the globe would let solar heat penetrate through but would retard its escape. The shroud would diffuse the heat and make temperatures more uniform from pole to pole. It would increase humidity, while at the same time reducing atmospheric currents and sudden temperature changes. It would foster rank growth of floral, even animal life, world-wide. Sunlight, reflected from the brilliantly illuminated atmospheric envelope hundreds or thousands of miles above Earth's surface, would supply twenty-four hour life-giving daylight from pole to pole, winter and summer alike. There would be no night-time as we know it on the hemisphere opposite the sun.

Barghoorn says (*op. cit.*, p. 243):

The development of coal-forming swamps close to the South Pole demands an explanation allowing for extraordinary climatic change. Botanically also, Jurassic floras present the curious anomaly of a well-differentiated vegetation developing under physiologic conditions of a polar night.

The explanation Barghoorn demanded is clearly furnished,

the anomaly he pondered is definitely disposed of, by recognition of the influence which a primordial cloudy shroud would exert upon global climate.

Future Uniformity Impossible

It seems to the writer that in no other way is it possible to account for greater uniformity of climate, from pole to pole, which we positively know has obtained throughout most of geologic time. In passing, let us note that such uniformity can never again eventuate, because no longer is there, or can there be again, such a hothouse roof of aqueous or other mineral matter to insulate the atmosphere. Although the latest Pleistocene ice has steadily dwindled and is still slowly melting away, it appears probable that earlier ice sheets disappeared more rapidly because the Earth was still blanketed wholly, or at least partially, by remnants of primordial clouds.

That glacial episodes were quickly followed by long periods of warm climate is, as we have noted, verified beyond doubt by voluminous evidence. Conditions we can see on other planets tip us off as to how and why this came about. Bands of clouds covering those planets are behaving just as Earth's primordial shroud must have behaved. As the bands of declining primitive aqueous clouds moved poleward from the equator, one after another, they constituted a greenhouse insulating roof or blanket over the globe, to absorb and let in solar heat, but retard its later escape. Thus, after the fall of an increment of snow or ice to inaugurate an ice age, and temporarily refrigerate the Earth, the insulating blanket would, geologically speaking, quickly melt away the ice and establish a succeeding uniformly mild climate, from pole to pole, to endure literally for an "age," until another sudden downfall of ice or snow would again inaugurate a glacial episode. That such a cycle of warm climate, succeeded by a shorter period of glaciation, has occurred time and time again is generally conceded. No theory previously advanced has even attempted to account for this cycle of climatic fluctuation.

Drowned Lands

As previously observed, the fact that increases in Earth's surface waters have occurred within geological time, definitely solves the mystery of subaerial erosion of canyons deep in continental slopes and far below sills of mediterranean seas. The increases account for drowning of mid-oceanic islands, ridges and sea mounts synchronously with submergence of world-wide continental margins. We now comprehend how "land bridges" and "lost continents," presently submerged, formerly existed to permit spread of floral and faunal species, as well as human cultures, religions and traditions between distant parts of the world now separated by wide expanses of ocean. Flint, in *Glacial Geology and the Pleistocene Epoch*, gropes for an explanation of how Folsom Man managed to cross from Asia to America over Bering Strait and make his way south to a region where survival was possible, over pathways made impassable by glacial ice sheets. We now realize that man crossed before the land bridge was submerged by increase of ocean waters and before the ice ages of that period eventuated.

Epeiric Seas

It has always been assumed that epeiric seas—former bodies of water in inland continental basins—were caused by subsidence of the involved areas below sea level. However, this theory is nullified by the fact that occurrence of epeiric seas was synchronous in all four quarters of the globe. It can scarcely be thought that simultaneous subsidence of land areas on every continent could have occurred. Alternation of submarine and subaerial fossils and deposits in the beds of former epeiric seas would mean that the land must have been alternately depressed and up-lifted time and again. This would be in conflict with the conviction of geologists that in the main, aside from major orogenic revolutions, continental platforms have been stable throughout geologic time.

Without relying upon the assumption that restricted areas of the continents have bobbed up and down repeatedly to account for such inland seas, does it not seem more probable that these "seas" were in reality lakes formed from deluges of primitive water which filled pre-existing continental basins until the waters overflowed the banks and cut channels to empty the lakes, or remained until they evaporated? Although fossils in the beds are predominantly lacustrine, others are of shallow marine types. The latter can conceivably be accounted for by the conception that the descending primitive waters which filled epeiric seas very probably were saline at times.

The theory that all the salt in oceans and dry lakes was dissolved and transported from rocks and soils on land seems questionable. If such theory is correct, how did the salt originally get in and on the land and whence did it come? Can anyone conceive a source other than the primordial atmosphere? In Chapter Five the origin of salt will be discussed further.

Pluvial Periods

Earlier we learned that among geologists it has always been considered paradoxical that so-called "pluvial" conditions apparently accompanied glacial periods. In harmony with the idea that frozen primitive water descending from space above built the ice sheets, it seems completely logical that either rain or melting snow and ice must have brought about pluvial conditions in global areas where ice sheets did not form.

It is evident that while frozen moisture was falling in some areas to build ice sheets, heavy rainfall no doubt was occurring in other areas, more or less all over the world. Hence we should no longer be mystified by contemporaneous existence of ice caps in some areas and pluvial conditions in others. We can now understand how the huge basin of central Asia was submerged by a much larger Caspian Sea; how Lake Bonneville in America and countless other "pluvial" lakes were formed and re-formed either by deluges of primordial water or by melt-water from glaciers.

Glacial Ice Changed Climate

Knowing that glacial ice came upon the world stage suddenly, we understand why we cannot find evidence that Earth's climate grew cold *before* the advent of an ice age; why, on the contrary, climate grew colder only *after* the ice arrived and only to the extent that the ice itself refrigerated the Earth, exactly like a chunk of ice chills an ice box. Hence we realize why glaciers began to melt immediately after deposition and why those of the last glaciation are still melting and shrinking, even in polar regions. We know why, although such an inconceivably vast amount of ice would melt exceedingly slowly by human standards, the duration of each ice age was very short geologically as compared with the duration of interglacial epochs.

Perma-Frost

The new conception throws light upon the mystery of "perma-frost" in high latitudes of Canada, Alaska, Siberia, etc. This unconsolidated soil is permanently frozen to known depths in places of more than a thousand feet. In the absence of a credible theory to explain this phenomenon, the assumption has always been maintained that the ground froze to such astonishing depths because of continued severe cold which caused glacial epochs. Yet it is a scientific fact that ground will not freeze to depths of more than a few feet, no matter how cold the climate. Latent terrestrial heat rising from Earth's interior, combined with high insulating characteristics of soil, successfully prevent frost from descending to anywhere near the depths of perma-frost.

This frozen soil often contains strata of clear, blue ice between strata of frozen glacial till and boulder clay. At the very bottom of them all, lying on bed rock, is found the placer gold of Alaska and Siberia. Obviously the perma-frost accumulated from the bottom upward—not by freezing from the top down-

ward. In some areas there are no evidences of former highlands from which sediments could have been eroded and transported to the areas of perma-frost. In the foregoing facts there are implications that perma-frost may be connected with glaciation, and perhaps with fall of gold and other mineral matter from a primordial atmosphere.

Changes in Life Forms

We have previously given an explanation of the enigma which scientists have never been able to solve, namely, how and why could temperate climate extend to within both polar circles. Scientists have been mystified by the fact of sudden disappearance of abundant life forms of air, sea and land. Sudden catastrophic deluges of chilling rain, snow and ice alone can explain such destruction of life and consequent termination of various "ages" which Earth has experienced. In contemplating the deluges of ice and snow which built the ice sheets on land, one visualizes tremendous quantities of snow and ice falling into and chilling ocean waters contiguous to lands which were being glaciated.

Quadral Sequence of Events

Sir Charles Lyell called attention to the fact that climatic change, extermination of species and change in level of the ocean were a triplicity of terrestrial changes which always occurred in that sequence. To these he should have added a fourth change. In accord with what we have learned in preceding studies, the order of occurrence, with the fourth change added, would be as follows: First came glaciation of land and rise of ocean level as the result of downpours of frozen and liquid water. Next came sudden lowering of climatic temperature, including lowering of temperature of ocean water. Third came destruction of species of life due to the two preceding events. Fourth came orogenic crustal plications characteristically ad-

jaacent to and parallel with oceanic margins of continental platforms, caused by increased loads upon ocean floors and necessitating uplift of sialic areas to maintain isostatic equilibrium.

The foregoing remarkable repetition of quadruple related events is clearly explained by the fall of successive increments of primordial aqueous and other mineral matter emanating from vast stores gathered in space above during the inveterate heat of Earth's formative, igneous eras. Consequent imposition of additional burdens of water, minerals and sediments upon ocean floors created resistless uplift forces directed shoreward and caused crustal upheavals along continental margins following at least the major downfalls.

Evidence of Terrific Erosion

It has been estimated that if Earth were a perfectly smooth ball, there is sufficient water in its hydrosphere to submerge it to a depth of some 10,000 feet. This would be enough water for 500 deluges, each flooding the entire surface of the globe to a depth of twenty feet! According to the theory that within geological time increments of primordial water descended from extra-terrestrial space above, it certainly is not illogical to assume that floods of that or even greater magnitude occurred on numerous occasions. It would not take many such deluges to account for tremendous and violent erosions and transport of crustal materials which clearly have taken place. No longer need we wonder how millions of huge valleys and canyons all over the globe, with vegetation-covered slopes, could possibly have been carved by run-off of mere rains in the case of dry valleys, or by puny little creeks occupying others. In many, many areas all over the globe, crustal material to depths of hundreds, even thousands of feet has been removed from hundreds of thousands of square miles and carried to the seas or deposited in inland basins. Much of this material was of recent age. Surely such enormous degradation could have been so quickly accomplished only by downpours and floods many times

greater than those occurring today—downpours which would be measured in fathoms instead of inches! In accord with this thought, it would seem possible that degradation may have progressed more rapidly and present distribution of crustal materials may have developed more recently than has been commonly believed.

CHAPTER FIVE

EARTH'S SEDIMENTARY CRUST

Prevalent Theory of Origin

IT IS THE CONCENSUS of geologists that all sedimentary rocks in Earth's outer crust were derived from older, igneous, crystalline rock masses. Kuenan elucidates this belief by saying (*Marine Geology*, p. 386): "All sediments are formed from weathered, older rocks, ultimately from igneous rocks." Dr. Frederick B. Peck, geologist, writing on the subject of "Rocks" in *Encyclopedia Americana*, says that "the oldest known rocks, the original or primitive rocks from which all others have been derived, are of igneous origin. . . ." Bradley, in *The Earth and Its History*, says (p. 185):

In the beginning, all rocks were of igneous origin; but by the time the Earth had acquired an atmosphere, the work of chemical and mechanical destruction had begun. From the resulting debris the first sedimentary rocks were formed. Thereafter throughout all geological time rock waste has accumulated in depressions in Earth's surface. In all cases such debris was derived from pre-existing rocks, whether igneous, older sedimentary or metamorphic.

Inasmuch as geological writings and teachings do not explicitly expound them, apparently there is neither a definite concept as to when the igneous rocks came into existence, nor a precise theory as to the manner in which they were formed. Evidently, it must be thought that as and when Earth's seething core had cooled sufficiently so that it could happen, a heterogeneous molten mixture of all elements and most compounds, previously formed and already contained within that molten

mass, solidified into a shell, or crust, of igneous, crystalline rock, from which the first continents and ocean basins were shaped. It must be presumed that after that barren, crumpled shell, or crust, had cooled and formed in place on the outside of Earth's core, and just as soon as decreasing heat of the core permitted, all water in Earth's present hydrosphere descended from the heavens above. Thereupon began weathering, erosion, leaching, transport and redeposition of sediments derived from that igneous shell.

It is held and freely stated by geologists that first one regional area of the igneous crust, then another, was uplifted into mountains or highlands, from which sediments were eroded and transported to accumulate deposits on other areas which at the time were submerged beneath the seas. The theory is that as one elevated region after another was peneplained in supplying sediments for other areas, the peneplained regions subsided below sea level so that they could in turn receive their covers of sediments from other mountainous areas. Thus the theory inescapably means that accumulation of sediments on any particular area, anywhere throughout the world, was an interrupted, intermittent, regional process. It definitely precludes the possibility that continuous, *planetary* deposition, as opposed to *regional*, could have taken place. The theory entails so many contradictions, improbabilities and inconsistent assumptions that surely it has survived only because no other idea has been conceived. In pages to follow, another hypothesis, based upon physical law and visible evidence, will be presented. But first let us review some other suppositions which are commonly held.

Components of Igneous Rock

The concept that all consolidated and unconsolidated mineral compounds and elements in Earth's sedimentary supercrust were derived from older igneous rocks demands that the source rocks must have contained all the elements and compounds now found in the supercrust, except, of course, compounds formed by chemical action during the process of weathering and de-

nudation. Due to the absence of intense heat, the only reagents and catalysts present during the process of weathering, leaching, erosion and transport were water, air and the chemicals they contained. Therefore, it must be assumed that igneous source rocks contained, either in pure or compound forms, nearly one hundred elements, including aluminum, calcium, magnesium, potassium, sodium, iron, manganese, phosphorus, chlorine, sulphur, carbon, silicon, etc., etc., etc. These elements or compounds of them are found world-wide in sedimentary deposits.

If all elements and most compounds were contained within Archean igneous rock, even the most volatile of those elements and compounds must have been held prisoner within the molten, burning mass while the mass was still incandescent and while it was cooling and hardening into a solid crystalline crust. Because of the high volatility of many elements and compounds, this seems quite impossible. Furthermore, some elements and compounds are entirely missing in igneous rocks today. Igneous rocks do not contain sufficient percentages of other minerals to have been the source of those minerals. For instance, sodium chloride: The prevailing theory is that salt was leached out of igneous rock and carried to the seas by water.

Salt in Oceans

The amount of salt in the oceans is almost inconceivable. It is estimated that if the Atlantic Ocean alone were evaporated, enough pure salt would be left behind to equal the combined volume of all the mountain ranges on Earth! Besides the salt in oceans, there are vast salt beds distributed widely throughout many land areas of the world. Ladoo and Myers, in *Non-Metallic Minerals* (pp. 436-37), say: "Salt deposits occur in sedimentary rocks of nearly all geologic ages since the early Cambrian." They point out that the great Permian salt beds in the United States cover an area of about 100,000 square miles and in places are more than 2,700 feet thick. In Germany, a test boring was put down through 5,000 feet of halite without

reaching the bottom of the bed. Other great deposits exist in many places over the globe.

The "bar theory" of Ochsenius to account for accumulation of such inland salt beds is generally accepted. This theory assumes that salt in the beds came from ocean water which flowed over "bars" into inland basins and evaporated as fast as it came in. How the salt previously got into the ocean gives no concern. According to the prevailing theory of its origin, the salt must have made a round trip from igneous rocks on land to the ocean and then back again to the land. Inasmuch as Archean igneous rocks contain, at the most, only an infinitesimal percentage of sodium chloride, an incredibly vast volume of such rocks would have been required to account for all the salt in the oceans.

Dr. F. J. Pettijohn, in *Sedimentary Rocks* (pp. 360-61), says that

complete evaporation of a 1,000-foot column of sea water would leave but 15 feet of salts, of which 0.4 feet would be calcium sulphate, 11.6 feet halite and 3 feet potassium and magnesium-bearing salts. Salt beds thousands of feet thick would therefore require evaporation of a very great volume of sea water, whereas the deposits bear evidence (mud cracks, etc.) of shallow-water origin.

He says that many evaporate deposits do not show the characteristics the theory demands and concludes that

simple evaporation of sea water did not occur, and either the present brine was not formed from sea water or the evaporation took place under special conditions that will explain the anomalies.

To assume that all salt in oceans and inland beds was leached out of plutonic, igneous rock, constitutes a denial that Earth was ever hot enough to vaporize sodium chloride and repel it to the primordial atmosphere. The assumption also necessitates the belief that salt was created and remained within the molten mass while the latter was cooling to form Earth's igneous rock shell. The chemical constitution of all igneous, crystalline, plu-

tonic rocks, as found today, certainly fails to sustain such an assumption.

Rather, does it not seem more probable that sodium and chlorine were combined into salt during some formative, incandescent, flaming stage of Earth's evolution; that the vaporized product was hurled aloft; that it remained in a revolving primordial atmosphere until Earth's core had cooled enough so that the salt vapors could condense and descend to Earth? This more logical conception makes it evident that the descending precipitates fell both in the oceans and on the lands. Falling thus on land, probably mixed with or dissolved in water, vast amounts quite naturally could either fall in restricted regional concentrations, just as snow and rain fall regionally today; or could, after falling, be washed to concentrated beds. Falling in the oceans, salinity of the latter would result without involving the assumption that all salt came from igneous rocks of the lands—rocks which, judging by the composition of igneous rocks today, never contained the salt.

Sulphur Deposits

Or, consider the case of elemental sulphur deposits. Sometimes, free sulphur is found in surface outcrops and in pits at shallow depths. However, large deposits of commercial importance are found at depths usually of from a few hundred to 2,000 feet. Many millions of tons of sulphur are required annually to fulfill the world's needs. In the United States alone some ten million long tons are consumed per year.

Sulphur, in its many allotropic forms, is the fourth most plentiful element on Earth and is widely distributed. In all cases, "free" or elemental sulphur, as distinguished from compounded sulphur, is a sedimentary deposit. In Sicily, the principal source of sulphur prior to 1900, sulphur is found associated with gypsum and bituminous marl and is mined like coal and iron. In and contiguous to the Gulf of Mexico, the principal source of the present world supply, elemental sulphur is found in porous

calcite overlying salt domes. It is melted underground by hot water pumped down into the deposits and is forced up to the surface in liquid form by compressed air. It is allowed to flow into huge "vats" where it cools and solidifies. To a considerable extent, however, it is shipped in hot liquid form to consumers. The product is more than 99% pure.

Free sulphur is not a chemical compound—it is a basic, nonmetallic element of complex atomic structure, insoluble in water—an element which must have been fused by the intense heat during Earth's earliest formative eons. On preceding pages we questioned how all the salt in oceans and on continents could have been accumulated from sediments eroded out of igneous rock. Now we wonder how free-sulphur deposits which overlie salt domes of the Gulf region could have come from a like source. If they did, where were the source rocks situated?

Characteristically, throughout the world, native sulphur is found in sedimentary beds closely associated with gypsum and calcite. How it was deposited and accumulated in such beds is a mystery which geologists admit they have been unable to solve. One theory is that sulphur and gypsum were deposited by action of hydrogen sulphide on calcium carbonate. Another supposition is that sulphur was formed through reduction of sulphate by organic agencies. It is also said that it may have been formed by certain anaerobic bacteria which are able to reduce mineral sulphates.

It would seem to be indubitable that, in the beginning, creation of the element sulphur must have preceded formation of compounds of the element. Hence it would appear illogical to imagine that free sulphur now on Earth was all derived from breakdown of sulphides and sulphates. If all free sulphur on Earth came from weathering of igneous rocks which formerly contained it, igneous rocks still existing throughout the world and available for analysis should corroborate the theory by disclosing considerable percentages of free sulphur as components. But they do not. The sulphur they contain appears invariably in the form either of sulphates or sulphides. Except for small

amounts accumulated from solfataras and mineral springs, free sulphur is found in appreciable quantities only in sedimentary rocks.

Strata Variations

But for the sake of argument let it be granted that the original crust of igneous rock did contain all elements and most compounds now found in Earth's aqueous, sedimentary supercrust. Some strata are siliceous, some calcareous, some aluminiferous, some carbonaceous, some metalliferous, etc. There are thick unadulterated strata of shales, of sandstones, of limestones, of dolomites, etc., covering extensive regional areas. Whether they were separated or indiscriminately mixed in the source rocks, how could such different chemical compounds be separately dissolved, or weathered and eroded, transported, without adulteration, over considerable distances and deposited each by itself in distinct, separate beds and accumulations? Certainly, detritus, which is being transported and deposited anywhere today, shows no sign whatsoever of any such sorting and differentiation. Invariably, the mixture, like the fellow in the song, is "all shook up." The farther sediments were transported and the more times they were "reworked," the less would they have remained distinct and separate from each other.

Furthermore, if igneous source rocks furnished sediments, say, for Cambrian strata, whereupon those Cambrian sediments were deposited upon the source rocks, covering and sealing the source rocks from weathering and eroding agencies, how could Silurian sediments be subsequently extracted from the buried source rocks? How could the Silurian sediments emerge up through the Cambrian cover to be deposited upon the latter? An identical enigma arises as to all subsequent deposits up through the whole geologic column: How could younger strata be extracted from buried source rocks and be deposited upon older strata, which covered and concealed the source rocks? Attempts to overcome this enigma are responsible for the theory of alternate upheavals and erosions of first one region and then an-

other, whereby the source rocks were exposed again and again to erosive agencies, enabling them to supply sediments for successive periods.

Sediments a Supercrust

Derivative, sedimentary rocks, except where "overthrusts" or volcanic ejectamenta have covered them, overlay igneous rocks beneath. Thus they form what may be called a supercrust. Obviously they were accumulated later than were the igneous rocks. There are of course restricted areas where ablation has removed a former cover of sedimentary rock, leaving exposed "shields" of "basement-complex" igneous rocks.

It is held that sedimentary rocks are either a mechanically accumulated detritus, such as sandstone, shale or conglomerate, or a chemical precipitate, such as rock salt or gypsum. It is the consensus of geologists that both classes of rocks came from weathering, chemical reactions upon, or leaching of, previously existing, indurated, igneous rocks. The original igneous rocks are assumed to have been situated at high, subaerial locales, from which the weathered material was eroded, transported downgrade by, and deposited as sediment in, water. The whole process of weathering, erosion, transportation and deposition can be clearly seen in operation today. Hence it is perfectly natural to conclude that the original and only source of sedimentary rocks was previously existent igneous rock masses.

It is held that as a result of peneplaining, in connection with successive crustal upheavals and subsidences, sedimentary materials have been worked and reworked time after time. Because the process of deposition in water can be seen at work today and because all sedimentary strata obviously were originally laid down horizontally and in parallel layers, it is assumed that the existence at any location of a veneer of stratified rock proves that the area at the time of accumulation was submerged either in a lake or in an arm of the sea which had temporarily transgressed the lowered land.

Contradictions

Surprisingly, the theory is not questioned, even though it develops contradictions. In many instances land fossils are found alternated with marine fossils in successive strata. To illustrate, way down below the rim of the Grand Canyon of the Colorado River, in Permian strata, again in the nearby Painted Desert, in Triassic strata, thousands of feet below top-most sedimentary strata of the Arizona-Utah Plateau, are footprints of short-legged animals and dinosaurs clearly impressed in solid rock. How come these lumbering land animals were able to walk on an ocean floor? Or had the floor, just at those moments, bobbed up from beneath the sea so that the old fellows could leave their "footprints in the sands of time" before the sands hardened into rock? If the latter is the true explanation, the surface must have sunk immediately after the awkward saurians passed, in order that subsequent layers of sediment could be deposited.

To overcome complications like the foregoing, proponents of the theory are obliged to assume that land areas time after time have been alternately uplifted and depressed above and below sea level. Yet such assumption conflicts with the general opinion that within geological time, aside from the great major orogenic revolutions, continental platforms and ocean basins have uninterruptedly maintained substantially their present relative positions. As Dr. Rachel L. Carson says in *The Sea Around Us* (p. 11):

In spite of theories to the contrary, the weight of geologic evidence seems to be that the locations of the major ocean basins and the major continental land masses are today much the same as they have been since a very early period of the Earth's history.

World-wide Distribution

So-called "derivative," sedimentary rocks underlie top soil throughout major portions of nonmountainous areas of Europe, Asia, Africa, Australia, North and South America, and very probably also Greenland and Antarctica. Such rocks also dominate or occur plentifully in both inland and coastal mountains everywhere, excepting only volcanic mountains and those of purely igneous, basement complex. They also occur in islands everywhere. From evidence thus far obtained from borings, dredgings and photography, it appears that they also underlie the silt on all ocean floors. (Those who contend that sedimentary rocks accumulated from deposition of sediments in the seas can scarcely afford to question the last statement!)

Sedimentary rocks are so prevalent throughout the world as to indicate that at one time virtually the entire surface of Earth's igneous, indurated crust must have been covered with a stratified, sedimentary supercrust; and that only subsequent weathering and transportation by wind, water and ice, have left some comparatively small and isolated areas devoid of such previous coverings.

Paradoxes

The theory that Earth's sedimentary supercrust was derived from older igneous rock, as was explained before, is predicated upon the assumption that first one and then another mountainous or highland region supplied eroded sediments to cover other areas which at the time were submerged beneath the sea. It is assumed that as time went on crustal uplifts and subsidences of regions to heights above and depths below sea level resulted in alternate areal accumulation and distribution of crustal sediments as we now find them. But the theory develops paradoxes. To illustrate, suppose areas A and B, let us say, during the Cretaceous period, were mountainous regions sup-

plying eroded sediments to cover adjacent area C, which at the time lay submerged on an ocean floor.

According to the theory, areas A and B, after being "peneplained," must have sunk beneath the sea, for they are now also covered with sediments. And when we examine the sediments, we find that they too are Cretaceous! But whence did they get their cover? Area C could not have furnished it, for area C is still covered with Cretaceous strata. What perplexes exponents of the theory is the difficulty of determining the whereabouts of assumed source rocks for sedimentary strata spread all over the globe. As we shall see later, some very questionable assumptions have been made in attempts to overcome this difficulty.

Ages of Sediments

Sediments are classified chronologically by the fossils they contain. Strata at the very bottom of the geological column show no signs of life. Strata next above contain fossils of the very lowest life forms. Progressing upwardly, succeeding strata contain fossils of life forms growing increasingly advanced. It is evident that lowermost strata are oldest and that those above were laid down one after another as time went on and evolution of life progressed. It is equally apparent that accumulation world-wide took place in the same sequence. Everywhere throughout the world, Archeozoic sediments are topped by Proterozoic; Proterozoic are topped by Paleozoic; Paleozoic are covered by Mesozoic and the latter by Cenozoic. Subdividing the sediments according to shorter geological intervals, we find that uniformity of sequence continues to hold good. Thus we find Cambrian strata covered by Ordovician; Ordovician covered by Silurian; Silurian strata topped by Devonian; Devonian topped by Carboniferous; Carboniferous by Permian, etc., etc., on upward to deposits of recent period. Irregularities, unconformities and breaks in the sequence occur only where tectonic forces have created "overfolds" of older strata over younger ones, or where strata of certain periods have disappeared due to ablation.

Intermittent Deposition

The concept that sedimentary rocks were derived from highland sources of older, igneous rocks, inescapably means that sedimentation necessarily was regional and intermittent; that any one region received sediments during some intervals but not during others. Accordingly, one would suppose that an unconformity disclosing a break in continuity of deposition would be considered evidence that during the period of time represented by the unconformity, the area of the latter was not receiving sediment because it was uplifted above sea level. But such does not seem to be the interpretation. It is held that unconformity—the missing strata—was due to erosion. For instance, Dr. R. R. Shrock, in *Sequence in Layered Rocks*, says (p. 43) that

every unconformity, large or small, and regional or local, was once a surface, and most of the surfaces were once exposed to the action of subaerial weathering and erosion.

He continues to explain (p. 47) that an unconformity “usually implies that a long period of denudation preceded deposition of the materials covering the unconformity. . . .” This admission that all regions were once covered with the missing deposits, contradicts the concept that first one region and then another was covered with sediments derived and transported from highland areas situated elsewhere. The contradiction would not necessarily apply to trivial purely local unconformities; but it would apply to breaks in continuity of geological periods.

By far the greater volume of sedimentary rocks is buried and unavailable for examination. Hence the absence of strata of a particular period in outcrops, railroad cuts, etc., is not proof per se of a “lost interval.” It is probable, and in many instances clearly evident, that the rocks which contained the records of those intervals once existed but were subsequently removed by ablation. As to other missing records, it is probable that they have merely not yet been exposed and found.

However, deposits of so-called "derivative" rocks of successive ages, from Pre-Cambrian upward to recent, as proved by the fossils they contain, are so widely and generally distributed over the globe that simultaneous, planetary deposition, as contrasted with intermittent, regional deposition is strongly indicated. Exceptions only prove the rule. Exceptions are areas where erosion has removed strata of some periods or has continued until underlying basement-complex shields have become exposed or where subcrustal igneous rocks have been extruded up through sedimentary rocks by tectonic agencies.

Mountains and Geosynclines

It seems somewhat paradoxical that the prerequisite for the formation of a mountain range, could have been the prior existence of an elongated submarine trough or geosyncline and the filling of it by sediments transported from other mountains or highlands. Yet such is the basic premise of the popular theory. Daly, in *Our Mobile Earth*, elucidates the theory by saying: "A geosynclinal prism is the preliminary condition for the formation of any major mountain range."

The theory, for instance, as to North American mountain ranges, is that the Appalachians, Rockies, Sierra Nevadas, Cascades, and Pacific Coastal ranges, originally were elongated submarine geosynclinal troughs; that the troughs were gradually filled during the ages by detrital sediments derived from elevated lands situated elsewhere; that some time, after filling of the troughs had been completed, the respective areas were uplifted into the present mountain ranges.

Daly says that the sediments accumulated to depths of from 10,000 to 50,000 feet. He explains that, as filling of the troughs progressed, subsidence of the synclines likewise progressed in order that sedimentation to the foregoing depths could result. He says that "as a rule, during the geological past, the sinking of the floor of each trough nicely kept pace with the loading."

Glacier National Park

Dr. James L. Dyson, in *The Geologic Story of Glacier National Park*, says relative to the mountains of that Park:

During the Proterozoic Era of Earth history a long, narrow section of North America, extending from the Arctic Ocean southward, probably as far as Arizona and Southern California, slowly sank to form a large, shallow, sea-filled trough known as a geosyncline. Inasmuch as thousands of feet of sediments were deposited, the geosyncline must have continued to sink throughout the period of sedimentation.

He says that the sediments are 20,000 feet thick. Hence he postulates a total subsidence of that amount. He says that after the trough was filled the land was uplifted to form the present mountains. The uplift obviously must have equalled the subsidence of 20,000 feet. The mountains of the Park are still some 13,000 feet above sea level after millions of years of denudation. Although sediments of some periods are missing in the mountains of the Park, sedimentation must have continued from Pre-Cambrian to as late as Cretaceous time, for rocks of the latter period are covered by "overthrust" of older rocks. Dr. Dyson suggests that the missing links are due to the fact that the Park area during the times represented by the missing strata was uplifted above sea level; that later it again subsided. Thus he contradicts his opening statement that subsidence was continuous throughout the total period.

Source Areas

Great study has been given to the problem of locating high-land sources of sediments now contained both in mountain ranges and in plains regions. Paleogeographical maps have been laboriously drawn for all geologic ages. Many conclusions are necessarily purely conjectural, involving the assumed existence of former high land masses for which no evidence is apparent.

This is admitted in a statement of Kuenan (p. 126) that "In constructing paleogeographical maps the *necessity* is frequently encountered of *assuming* former regions of denudation outside the present limits of the continental blocks." (Italics added.)

Nevin says (*Principles of Structural Geology*, p. 288):

A study of mountain ranges bordering coast lines has shown that the sediments which make up these folded mountains must have been derived from large land masses that existed where the ocean now is. The source of the sediments which compose the Appalachians was from the east; and the volume deposited indicates the former presence of high land considerably beyond the edge of the present continental shelf. Likewise the source of sediments which form the Andes was from the west, right where the deep Pacific Ocean now exists.

H. G. Richards, in *Record of the Rocks* (1953), says (p. 113) that the sediments which filled the "Appalachian Geosyncline" were "carried down from highlands on the two sides of the geosyncline." He says that the land to the southeast of the geosyncline "was high and mountainous" and "may, at times, have extended as much as 100 miles east of our present shore line."

Those who accept the foregoing assumptions conclude that after former off-shore highlands were denuded to supply sediments for the geosynclines of present coastal mountains, they subsided to become and remain parts of oceanic floors. Yet, strangely, Nevin says (*op. cit.*, p. 287): "Once given a continental block, there appears to be no reasonable way by which the density may be permanently changed the amount necessary to sink it and keep it on the ocean floor." Does he contend that whereas an entire platform could not sink, substantial coastal segments extending "considerably beyond" continental shelves could do so?

Speaking of rock strata in Glacier National Park, Daly says that lands east and west of the Park supplied sediments for those rocks. Dr. Dyson states that the geosynclinal trough which subsequently was uplifted to form the Rocky Mountains was filled with sediments derived "from adjacent lands." If what

Messrs. Daly and Dyson say is true, how do they explain the fact that rocks of the very same ages as those in the Rockies are found westwardly clear to the Pacific and eastwardly clear to the Atlantic?

Colorado-Arizona-Utah Plateau

The Grand Canyon, Zion and Bryce Canyon parks together contain strata of every geological period from Pre-Cambrian to Pleistocene, with the exception only of Ordovician and Silurian. At least the latter two are not exposed in the Grand Canyon. Except for discontinuous and very thin Devonian strata, late Cambrian rocks in the canyon are directly overlain by early Carboniferous. However, it is conceivable that the missing strata may underlie other areas of the plateau; hence their absence in the Grand Canyon is not considered proof that they were not deposited because the region was uplifted above sea level during those periods. Rather, it is believed by many geologists that the missing strata were eroded during the long lapse of time between the Cambrian and the Devonian.

Apparently the region between the Rockies and the Sierras must have uninterruptedly received sedimentation throughout geological time and, if the orthodox theory of sedimentation is correct, the region continuously remained submerged below sea level. From data so far obtained in exposures and from well drilling, there can be little doubt that like sedimentation continued also east of the Rockies. Unfortunately, exposures even remotely approaching those in the Grand Canyon do not exist in eastern areas to make determination definite. That strata of a given period are missing in regional exposures eastwardly does not necessarily prove that they did not once exist there. Certainly, it is just as reasonable to believe the missing strata once existed but were subsequently removed by ablation, as it is to conclude and insist they never did exist because, during that particular period, the region stood above sea level.

Rocky Mountain Sediments

Did then sediments for the Rockies, which Daly and Dyson say came from the east, originate far away in the region of the Canadian Shield? Those coming from the west could have come neither from the basin to the west, nor from Pacific Coast ranges, for both the basin and those coastal mountains contain rocks of the same ages as some of those in the Rockies. This seems to leave only the alternative supposition that if the sediments came from the west they originated in distant mountain ranges which then existed off-shore where the deep Pacific Ocean now lies. Is this one of the instances Nevin and Kuenan say are "frequently" encountered where existence of former mountains must be "assumed" in order to provide a source of sediments which filled inland basins and synclines? H. G. Richards, in *Record of the Rocks*, p. 117, adopts such an assumption in demarking a source of sediments which filled the Cordilleran Geo-syncline. He says: "To the West [of the Cordilleran Syncline] . . . was the land of Cascadia, which extended westward into the present Pacific Ocean."

Isostacy

Thomas R. Henry, writing in *The White Continent* about coastal mountains which were explored in Antarctica, says:

They are built up of layer after layer of sedimentary rocks. . . . The rocks, approximately 15,000 feet in thickness, are old ocean bottom; they are the compressed, petrified erosion of a continent, swept into the sea by floods, rivers and winds over millions of years.

He makes no attempt to designate the location of the highlands from which the sediments came, except to say that they came from erosion of a "continent." He does not state whether he believes that the sediments came from the continental side or from the oceanic side of Antarctica.

Does it not seem contrary to the principle of isostasy that an ocean floor, after receiving a load of 15,000 feet of sediment, should rise up to form mountains 15,000 feet above sea level? Kuenen says (*Marine Geology*, p. 548) that "there are no indications in stratigraphy that true ocean bottom has ever been transformed into continental masses."

Exactly opposite results are presumed to have occurred as regards highlands alleged to have formerly existed off continental margins where ocean waters now are. As we have seen, they are said to have constituted the sources of sediments which filled certain inland geosynclines. It is claimed that after such off-shore mountains were peneplained, they subsided and became ocean floor. Contrarywise, as to geosynclines in inland areas, it is alleged that after the sediments in them accumulated to depths of from 10,000 to 50,000 feet, the synclinal areas were uplifted to form immensely high mountain ranges!

If there is any truth in the theory of isostasy, if continental platforms stand above sea level because they are constituted of sialic material, if ocean floors remain submerged because they are simatic, how could off-shore mountain ranges, especially after denudation, subside to become and remain ocean floor? On the contrary, how could an ocean bottom, as Mr. Henry calls it, after receiving a load of 15,000 feet of sediment, rise up to form a mountain range 15,000 feet above sea level? How and why could forces which compelled sialic land platforms gradually to subside from 10,000 to 50,000 feet below sea level, thereafter reverse their direction to uplift the same areas to great heights above sea level?

Flat statements, like several which have been quoted, that mountainous land areas formerly existed off-shore of present continental platforms where now deep ocean waters flow, illustrate conclusions often reached a priori in efforts to pinpoint sources from which sediments for certain areas could have come. There is no actual, definite evidence that deep, off-shore ocean floors ever existed as mountain ranges on the continental blocks.

Permanence of Continents

The assumption that portions of continental platforms were alternately depressed to depths of from 10,000 to 50,000 feet below sea level and thereafter were uplifted to great heights above sea level, conflicts with accepted ideas about permanence of land areas. For instance, Nevin points out that wherever the "old cornerstones" of the continents have been exposed by erosion, they are found to be igneous and metamorphic rocks; that

these nuclear masses or shields seem to have come into existence in the Archeozoic and since then have remained almost continuously above water. . . . By inference, the basement underlying the areas masked by sediments—about two-thirds of the continental areas—is composed of this same type of rock.

He concludes that "the facts point clearly to the very old age and permanence of the continental blocks. . . ."

Nevin goes on to say that "on the continents there is an almost complete absence of deep-sea sediments." He states that if the continents had ever been ocean floors, evidence of deep-sea oozes should be found. He asks:

If continents are permanent features, because of their relatively light density, how was it possible to submerge a considerable part of them to great depths?

Daly says (*Our Mobile Earth*, p. 129) that "geologists know of no case where regional uplift of a mile or so has soon been followed by subsidence of the same region and of the same order." According to Kuenan (*Marine Geology*, p. 126), it is held that

if oceanic floors are never elevated to form part of continental masses, the opposite process, the subsidence of sialic areas to oceanic depths, cannot then be reasonably assumed.

It is said that no interval of geologic time is known when at least the majority of continental areas was not above sea level. If all of North America was never submerged, how can

we explain why all of it, with the possible exception of portions of the Canadian Shield area, is or has been covered with sedimentary rocks from Pre-Cambrian time upward? Was all the continent covered with sediment which came from an earlier, much more elevated Canadian Shield of igneous rock only? Could sediments from that single source be transported to such great distances and distributed so efficiently as to cover all the remainder of the continent? Did sedimentary rocks in Mexico and Central America also come from the Canadian Shield, or did they come from mountains which formerly existed off-shore to the west where the deep Pacific now is, or to the east from mountains now lying beneath deep Caribbean waters?

Whence came sediments of stratified rocks which generally underlie South America, Australia, Africa, Europe, Asia and probably Antarctica and Greenland? Can we believe they came from former mountain ranges which, after being denuded to supply sediments for the continents, subsided thousands of feet to form present floors of oceans, which surround all land platforms? Certainly, sediments for world-wide stratified rocks could not have been derived from the regional, infrequent shield areas where igneous, subcrustal rocks of basement complex are exposed.

Down-Warping

Daly believes that "each geosynclinal prism has developed in consequence of prolonged down-warping of the Earth's crust" (*op. cit.*, p. 220). He presumes that lateral squeezing forces thereafter caused "crumpling" of the prism; and that "after a long interval of time—millions of years—broad up-warping of the fold-thrust belt occurred" (p. 239). Just why "down-warping" should be a prerequisite for "up-warping" caused by lateral pressure is not explained. It would seem that lateral squeezing forces, acting upon a down-warped prism would more probably exaggerate the syncline, rather than reverse the direction and create instead an anticline.

Either horizontal or anticlinal strata lying upon Earth's outer

shell, if squeezed between opposite horizontal forces, obviously would be forced upward in the direction of least resistance. But if the strata were down-warped in a syncline, the vertical components of the horizontal forces would be downward, not upward. To this writer it seems more probable, as was suggested earlier, that the formation of mountain ranges, which has predominantly occurred parallel with and contiguous to oceanic or mediterranean shores, was due to the following forces: the superimposed weight of additional water and sediments accumulating on ocean floors, generated down-thrust of the floors upon Earth's subcrustal simatic magma, thereby compelling up-thrust of contiguous marginal areas of lighter sialic continental platforms in order to maintain terrestrial equilibrium.

It is apparent that the problem of finding credible sources of sedimentary rocks for North America alone staggers the imagination. When one reflects upon the task of finding sources of sediments for both inland and coastal areas of Alaska, Siberia, Scandinavia, China, Malaya, Indonesia, India, Europe, Africa, Australia, South America, Antarctica, etc., the problem assumes impossible proportions.

Intent of Criticisms

The foregoing criticisms of the theory that all sedimentary rocks were derived from older igneous rocks are not intended to deny that igneous rocks where exposed have been weathered and eroded. Neither do the criticisms deny that crustal materials have been worked and reworked through the ages. Finally, they do not deny that some areas of land have sunk and others have risen. Such isostatic adjustments must continue so long as rocks disintegrate and rivers carry their immeasurable burdens to the sea. Adjustments must continue so long as conservation of energy remains a universal law. The criticisms are intended only to point out that by no means does the popular theory clearly explain accumulation of the sedimentary crust in the form and arrangement in which we now find it.

After reviewing contradictions inherent in the orthodox the-

ory of sedimentary crust origin, it would seem that students have clung to the theory only because no other source has been conceived. An alternate and more credible source will be clearly disclosed if we but give study to how some of Earth's physical characteristics may logically be thought to have evolved.

Components of Primordial Atmosphere

As noted in our study of oceanic mysteries, geologists and physicists admit that when Earth was igneous, all water now upon and within it was vaporized and repelled to space above. If the primitive, igneous Earth nucleous had been merely hot enough to vaporize water alone, then the primitive atmosphere would have contained little besides water vapor; but we know the Earth was immensely hotter than that, hence its primordial atmosphere must have contained vapors of whatever other minerals were volatilized by the tremendous heat; and it indubitably follows that just as surely as hot vapors can contain more mineral matter than cold ones, when the core and atmosphere cooled, the mineral vapors condensed and eventually descended as precipitates from that atmosphere.

Earlier in our studies we looked up at the cloudy shroud which obscures Jupiter's core, and we concluded it must contain many elements and compounds. We reasoned that gravital forces in due time will compel those minerals to descend to Jupiter's surface. We concluded that some day those minerals will contribute to a stratified, "sedimentary" supercrust covering an older, igneous Jovian core. Accordingly, there seems to be great support for the supposition that much mineral matter in Earth's supercrust came originally from a similar atmospheric shroud.

If, as geologists insist, it were true that all water descended as soon as cooling of the igneous crust had progressed sufficiently to permit water to remain, it would likewise be true that all other volatilized elements and compounds in the primitive atmosphere also descended in their entirety as soon as heat ceased to keep them suspended. Had this happened, the precipitates would have been deposited upon the igneous crust,

not in distinct beds of differing substances as we find them, but in one vast homogeneous mass, many thousands of feet deep. Had this occurred, all subsequent beds would have had to be extracted from that homogeneous mass. How, then, could the many different mineral elements and compounds have been separately extracted, separately transported and separately deposited in distinct, individual beds as is so characteristic, world-wide, of sedimentary strata?

Minerals Descended Intermittently

From our previous studies does it not seem more probable that the various components of the primitive atmosphere, including water and other minerals it contained, instead of descending in one grand installment, condensed, lost momentum and descended intermittently over the ages, in many increments more or less in accord with their respective weights and volatilities? Such a conclusion cannot be lightly dismissed as fantasy when there is clear, definite, logical support for it in conditions distinctly visible on at least two, if not four, of the superior planets. Looking at those planets, how can we possibly escape the conclusion that much of the elements and compounds now found in Earth's sedimentary supercrust was precipitated from a primitive atmosphere which continued to revolve in space above until long after the igneous crust had hardened. How can we doubt that much of the supercrust is not the child of an older igneous crust—a subcrust—which is still mostly buried by the supercrust and thus sealed from weathering and erosive agencies.

After much of the mineral matter in the supercrust was thus originally deposited more or less in separate, segregated aggregations of differing constituents, the processes of weathering, erosion, leaching, transport and redeposition began and continues to this day. All principles of leaching, weathering, erosion, transportation and sedimentation involved in the theory that the sedimentary crust derived originally from igneous rocks apply just as precisely to the above alternate theory of origin,

with the very significant exception that repeated illogical uplifts and subsidences of lands and ocean floors are not required to be assumed. The process of decay, erosion and transport operated synchronously, world-wide, in most areas, upon sedimentary rocks already at hand. Thus, today there are areas where complete ablation of former sediments has eventuated. There are other areas where original sedimentary strata have been only slightly eroded and which therefore remain much as they were when precipitated from aloft. While the greater part of mineral matter contained in the primordial atmosphere very probably was precipitated to Earth far, far back back in pre-geologic eons, soon after the igneous crust had hardened, there is evidence that remnants of that primordial atmosphere (certainly remnants of water, as we shall later see) descended to Earth very recently, even within historical time.

The foregoing alternate concept of origin explains many anomalies inherent in the theory that all sedimentary deposits accrued from decay of the Archean crystalline crust. Certainly the concept derives strong support from conditions clearly visible on other planets. It cannot be lightly dismissed as pure fantasy in view of that supporting testimony. It is evident that man has utterly failed to comprehend apparent lessons taught by those visible planetary conditions. Lessons they teach are the very heart of the theory we have been exploring. The theory cannot be refuted unless and until the assumptions suggested by conditions existing on the planets are proven false.

Let us review the principles of the theory.

CHAPTER SIX

REVIEW—IMPLICATIONS—CONCLUSION

Elements Fused by Formative Heat

IF EARTH WAS EVER IGNEOUS—and almost all scientists firmly believe it was—it seems unquestionable that all the elements and most of their compounds were fused during that igneous, incandescent, gaseous stage of evolution. It seems unquestionable that the vaporized products were repelled from the nucleus of the flaming mass to distances more or less proportional to their weights and volatilities; that they were hurled into revolutionary motion by the same agency, whatever it is, that gives such motion to all celestial bodies. It seems indubitable that, as cooling progressed, the atmospheric vapors condensed into liquids or solids, according to their natures. That water must have been a prominent constituent of those atmospheric minerals and was mixed with or contained some minerals dissolved within it, seems entirely logical. Because of its light weight and high volatility, at least some water must have been among the last of the vapors to condense and return to Earth.

Descent of Atmospheric Minerals Slow

Laws of motion and conditions visible on other planets tell us that long after formative heat of the contracting nucleus or core decreased to the point where heat no longer prevented descent, some atmospheric minerals must have continued to revolve around the core until gravity finally slowed them down to less than orbital velocities. As and when retardation progressed sufficiently, the atmospheric minerals finally descended.

That the final descent must have been very slow is demonstrated by the "sputniks," or artificial satellites, which at this writing have been hurled to the skies. If some of these satellites, not more than a few hundred miles above the Earth, moving at an initial velocity of not more than seventeen or eighteen thousand miles per hour, can stay aloft and continue to circle the Earth for months, we can easily comprehend why the minerals in Jupiter's shroud, traveling some twenty-seven thousand miles per hour and thousands of miles above the planet's core, continue their revolutions, notwithstanding the fact that heat has long since ceased to repel them.

Accordingly, there would seem to be no reason whatever to doubt that Earth's supercrust originally was merely the precipitates of atmospheric vapors fused and hurled to space above by intense heat during Earth's formative eons. What other source can possibly be imagined? As a matter of fact, if Earth was once a flaming, incandescent, gaseous mass, every ton of matter in its core and every gallon of water in its hydrosphere, was accumulated from a former atmospheric, vaporous mass. Indubitably, accumulation must have been progressive.

It seems incredible that science has so completely failed to grasp the foregoing simple truths in spite of the fact that they are so clearly broadcasted by conditions plainly visible on several planets. With the foregoing basic principles in mind, one cannot look at Jupiter or Saturn without seeing in them perfect confirmation of those truths. Can anyone produce a logical reason to doubt that clouds which obscure the core of Jupiter today are essentially identical with those which once covered Earth's core? Can it be doubted that minerals in Jupiter's shroud are identical with those in Earth's crust and will in due time descend to the Jovian core to form its layered supercrust? Can anyone doubt that water is a prominent component of Jupiter's clouds, as we have reasoned it was also prominent in Earth's primitive atmosphere?

Based upon spectroscopic examination alone, some observers think that the planetary shrouds are methane and ammonia, containing little if anything else. Some have asserted that the

clouds of Venus contain no water. Such conclusions seem quite contrary to logic. Furthermore, conclusions based solely upon spectral analysis of planetary atmospheres cannot help but be inconclusive because the spectra are merely those of faint reflected sunlight shining on those atmospheres from distances of hundreds of millions of miles. Hence what the spectroscope reveals is not virgin light from incandescent planetary substance. Such flimsy evidence seems quite inadequate to refute the logical conclusion that minerals in the planetary shrouds are identical with those in the Sun, the Earth and every other member of the solar system.

Horizontalism

The horizontalism and parallelism with which stratified rocks obviously were originally laid down, apparently without exception over the whole surface of the globe, both on the continents and under the seas, constitute an enigma. Was the Earth as smooth and round as a bowling ball when precipitation of mineral matter from the primitive atmosphere occurred? Were there no hills and valleys then? Did the first increments of ocean waters cover the entire globe, with no land exposed? Were the first primitive atmospheric precipitates deposited in water which covered a perfectly smooth igneous shell? Was that shell only thereafter buckled and crumpled into deep ocean basins and uplifted into continental platforms? Did weathering, erosion, transport and redeposit begin only thereupon? At any rate, the mystery of horizontalism is certainly not augmented by the conception that sedimentary minerals were precipitated, at least in part, from a primitive atmosphere instead of having been derived solely from decay of plutonic rock masses and deposition of the resulting debris in the oceans.

Catastrophes

Pages of geological literature, old and new, are full of confessions of inability to discover sources and unravel mysteries of natural phenomena. As Georges Cuvier says in *Essay on the Theory of the Earth*:

. . . it is in vain that we search, among the powers which now act at the surface of the Earth, for causes sufficient to produce the revolutions and catastrophes, the traces of which are exhibited by its crust.

Scientists have long tried in vain to discover the origin of vast deposits of unconsolidated sand, gravel, clay, loess, widely scattered "erratic" boulders, the scorched stones of the "Harras" and the red sands of Arabia, of abyssal nickel, meteoric dust and boulders on ocean floors far from land, etc., etc., etc.

Evidence is conclusive that vast areas of the Near East, fertile and populous in ancient times, were devastated and made inhospitable by sudden, strange, deep deposits of dust, sand, gravel and boulders. Deserts in northern Africa, in southern Russia, in the Arabian Peninsula and elsewhere are relics of such catastrophes. Thriving cities were literally buried. Civilizations came to an abrupt end. Population in some areas was completely annihilated; elsewhere severely decimated. There is evidence that such catastrophes occurred on several occasions, some within the past few thousands of years.

Whence came those strange, deep deposits of regolith which so suddenly and violently wreaked destruction on vast areas of fertile, well-watered, populous, hospitable lands? Is it fanciful to conclude they may have come from the sky above—from primordial atmospheric clouds? Certainly, the conception is not more fantastic than the popular planetesimal theory, according to which the Earth and other planets were formed in their entirety by infall of meteoric stones from space above.

Localized Deposits

Does not the conception also disclose a logical source of localized, separated, erratic deposits of mineral elements and compounds—of sulphur, graphite, sodium-chloride, gypsum, hematite and countless other sulphides, sulphates, chlorides, carbonates, nitrates, oxides, etc., etc.—localized deposits which it is difficult to believe could have been extracted and transported separately from igneous rock masses? It is logical to suppose that just as snow and rain fall today, intermittently and regionally, so also did precipitates from the primordial atmosphere fall. A fall of siliceous matter could cover some regions and skip others. A subsequent fall of calcareous matter could cover the foregoing siliceous deposit or skip it and cover other areas. Other falling increments could be micaceous, ferruginous, carbonaceous, etc. All falls could be separate from or accompanied by water. Great sedimentary deposits of iron and copper and silver and cobalt ores could be precipitated upon plutonic beds of the Canadian Shield in the Lake Superior region and could skip contiguous areas to the north, south, east and west of that region. How else could those metallic sediments be deposited upon the outside of Earth's Archean, plutonic, igneous crust? How else could Alaskan and Siberian placer gold dust and nuggets be deposited upon igneous bed rock at the very bottom of a deep accumulation of a superimposed regolith?

Cosmic Origin of Till

There would seem to be no reason to doubt that some mineral elements and compounds condensed and coalesced in Earth's cooling primordial atmosphere into particles of every size, from impalpable dust to boulders of great size. Gravitative action, coupled with friction and revolution at high velocities in space above or in the upper reaches of the air, particularly if they were mixed with water, as they probably largely were, most assuredly would tend to form or wear the coalesced par-

ticles into rounded shapes just as effectively as would running surface water.

Hence is it not reasonable to suspect that some of the tremendous quantity of smoothly worn, rounded, even striated, "stones" and "boulders" of every size, copiously mixed both in unconsolidated material and indurated conglomerate strata, and widely distributed upon and within the supercrust, fell to Earth from the primitive atmosphere, usually, but not invariably, accompanied by water? Transportation and deposition of such immense quantities of surface, "drift" material throughout the world by the agency of glacial ice, as theorists predicate, seems open to doubt. Furthermore, the debris which is presently accumulating as the product of glacial erosion and ablation certainly is far different in physical characteristics from that of till. May there not be a tendency to attribute too much effect to the grinding and transporting "work of the glaciers." After all, glaciers covered only one-third of land area. Accumulation of such large amounts of unconsolidated or indurated material at many locations through the agency of running surface water seems questionable because it necessitates assumptions not supported by definite evidence. Accumulation, by the agency of running surface water, of any sedimentary deposit, be it rock, gravel, sand, sulphur, gypsum, salt, phosphate or what not, necessarily is predicated on the assumption that previous rock masses existed at higher altitudes than those of the present deposits. Definite evidence that such higher rock masses ever existed in many areas on Earth is lacking.

Water in Primordial Atmosphere

Inasmuch as water constitutes one of the more plentiful mineral components of Earth and because it volatilizes at low temperature, we cannot doubt that it was a very prominent component of the primitive atmosphere. Because it mixes freely with and also readily dissolves many elements and compounds, it undoubtedly brought down with itself considerable quantities of sedimental crustal substances. However, in other in-

stances, water surely came down separately, by itself. As said before, it requires little imagination to perceive that at times water descended in sudden, cataclysmic deluges of rain in tropical zones, or of snow and ice in temperate and polar regions.

Unquestionably, the increment of primitive atmosphere which descended to form the ice sheets still lingering on Earth was almost completely composed of water. Undoubtedly, too, the falling moisture which built the last glaciers, and/or that which man has recorded as Noah's flood, was the very last increment of primordial atmosphere to descend. The story of Noah's flood will be discussed later.

Origin of Coal

Among other geological mysteries which the theory throws new light upon, is the one concerning the true origin of coal. One need only read what any encyclopedia or any textbook says about the origin of coal to see clearly that no generally accepted theory therefor has yet been produced. The thought that carbon in coal emanated from Earth's primordial atmosphere is the first and only alternative to the questionable vegetal theory. The latter is based on the supposition that beds of peatlike remains of leaves, stems and roots accumulated from dense vegetation growing in inland and sea-border swamps; that these vegetal remains were later submerged by crustal subsidence and thereafter buried by aqueous sedimentation of rock-making minerals, the weight and pressure of which, coupled with an imaginary chain of vague chemical reactions, converted the vegetal material into coal. The theory supposes that the sedimental cover material came from erosion of higher land surfaces, locations undetermined. The theory further supposes that after one coal bed was thus formed and covered with sedimentary rock, the area experienced crustal elevation or a pause in subsidence whereby another swamp was formed to encourage an ensuing dense vegetal growth, thus initiating a repetition of the cycle.

In Westphalia, there are 117 beds of coal, one above the

other; in South Wales, 100 beds; in Nova Scotia, 76 beds; in Pennsylvania and other coal regions all over the globe there are multiple layers of coal, always with sedimental strata of clay, shale, limestone, etc., in between. These rock strata vary in thickness from a few inches to hundreds of feet. Coal strata vary from paper-thin to many feet in thickness. E. S. Moore in *Coal* cites seams at Morwell, Australia, 266, 227 and 166 feet in thickness. Some authorities say a coal seam of any thickness would require a bed of vegetation ten times as thick to produce it. Moore says the bed of vegetation would have to be twenty times the thickness of the coal seam.

Coal seams 50 feet thick are not uncommon. To allow such a bed of coal to accumulate, Earth's crust, in order to maintain swampy conditions where the vegetation was growing, would have to subside gradually and continuously, the rate very finely regulated to keep pace with the growth, until a bed of vegetal residue at least 500 feet deep accumulated. A coal seam 266 feet thick, would necessitate gradual subsidence until a bed of vegetation 2,660 feet thick accumulated. According to Moore, the bed for the latter coal seam would have to be 5,320 feet thick. Thereupon, sudden additional subsidence would have to occur to arrest vegetal growth and provide a depth of water sufficient for sedimental rock-making material of the roof over the coal to accumulate. Thereafter, following accumulation of the roof strata, crustal emergence would have to take place to an amount just exactly sufficient to form another shallow swamp, etc., etc., etc. There are many instances where layers of coal between rock strata are almost paper-thin. In such cases subsidence to arrest vegetal growth and permit deposit of sediment upon the meager vegetal remains would have to occur suddenly, almost as soon as the swamp was formed. How can anyone believe that such amazing cycles of perfectly regulated and timed subsidence and emergence of Earth's crust at an isolated spot on Earth could be repeated as many as 117 times, or 76 times, or even 10 times?

"Partings" in coal seams are common. Often in such cases a seam of coal is split horizontally, divided into two parts, an

upper and a lower, by an intervening wedge-shaped stratum of rock which increases in thickness from nothing, where it begins in the coal seam, until it separates the seam into two parts with a rock stratum which attains in instances many feet in thickness. Such wedge-shaped rock partings pose a mystifying problem for proponents of the theory that coal is the product of decayed vegetation which accumulated in swamps.

Fossils in Coal

In coal mines fossil impressions of ferns and other delicate plants are frequently found in the coal. Fossils even of large tree trunks are often found, some lying horizontally and many standing vertically in the coal seams and extending upward into and through overlying strata of rock. How could this be if coal was formed from slowly accumulating vegetable residue?

Take a case where a fossil tree trunk punctures a coal seam 5 feet thick, and extends upward another 15 feet into the rock roof over the coal. According to the prevalent theory of coal formation, a bed of vegetal residue at least 50 feet deep would have to accumulate to form the 5-foot coal seam. Obviously, at least many hundreds of years would elapse while a bed of peat 50 feet thick was accumulating. How could a tree continue to grow in a peat bed fifty feet thick, then continue to stand and grow while a massive strata of sand or clay sediment was being deposited around it to bury and crush the vegetation into coal? It would be impossible.

The fact that vegetal fossils, spores, pollen, etc., are found in carbon beds of coal no more proves that the carbon came from vegetation than do vegetal fossils found in clay, lime or sand beds, prove that the clay, lime or sand beds are of vegetable origin. Vegetable fossils in coal are carbon because they were buried in carbon; in limestone they are calcareous because they were buried in calcareous sediment, etc., etc. Human fossils have been found in sedimentary rock; but we do not therefore conclude that the rock is of human origin. Fossils of vegetation are even more common in clay beneath and in the roof

above coal than they are in the coal itself. Consistency would require us to conclude that the floor and the roof were also formed from vegetation.

Distribution of Coal

How can the theory that coal is a product of rank vegetation square with the fact that no great deposits of coal are found in tropical regions of Earth? If the theory is correct, why is coal found in the greatest amounts in upper latitudes, even within both polar circles, rather than in tropical latitudes, where dense vegetation necessary to produce it would thrive best?

Carbon Preceded Plants

It is quite incredible that production of the immense quantity of carbon which coal constitutes could be due to the puny agency of plants. Is it not obvious that carbon was present on Earth long before the first plant began to grow? Every ounce of carbon now in the form of coal obviously must have been fused in the laboratory of formative heat long before the first plant appeared. Why imagine that plants produced carbon already on hand? Plants merely appropriate and absorb existing carbon as an ingredient and a prerequisite in their growth. The crust of Earth contains untold millions of tons of carbon in many forms, coal being but one form. Even the air contains much carbon. Furthermore the theory that peat forms coal is quite unbelievable on its face. No place on Earth does peat even faintly resemble coal, either chemically or physically, except that it will burn. Peat, wherever found, is still peat. Nowhere does it closely approach the physical nature of coal. Neither is there any indication whatsoever that coal is being formed today in swampy areas anywhere on Earth. The notion is pure fantasy.

Carbon Fell From the Sky

Arguments to refute the notion that coal is of vegetal origin can be multiplied by the dozen. To the writer's mind, they all tend to prove beyond doubt that the carbon in coal fell from the primordial atmosphere, either mixed with or separate from water, sometimes falling in bodies of surface water and sometimes falling or washing upon and around growing vegetation. What else could account for the existence of fossils of standing trees in strata of coal and solid rock? The trees obviously were alive, growing on dry land when suddenly buried. The coal could not possibly have been formed from slow accumulation and decay of vegetation growing at that spot at that time. Fossilized trees and whole fern leaves, pollen, etc., found in coal show conclusively that the coal did not come from vegetation growing on the spot. Rather, they prove that the carbon was washed to or fell upon the spot.

Of course it seems almost impossible that in 117 successive instances carbon, alternated with other rock-making minerals, could fall upon or be washed to and confined upon one small area of Earth's surface. But to believe that those substances fell there from the sky, just like rain or snow do today, or that, after falling elsewhere, were washed to that area by running water, at least seems less difficult to believe than that swamps formed and vegetation alternately grew and perished due to alternating upheaval and subsidence of Earth's crust at an isolated spot, repeated successively 117 times!

It is held that graphite, another form of carbon, is also of vegetable origin, like coal. Graphite is a very abundant mineral in the oldest Archean beds—beds formed long before vegetation first appeared on Earth. Hence how could graphite possibly be a product of vegetation?

Origin of Petroleum

In passing, it is suggested that very probably the source of asphalt, petroleum and other bituminous compounds was the primordial atmosphere. Chemists and geologists have been completely unable to determine and to agree upon their origin. Neither can they diagram the chemical reactions which would change organic matter to them. They cannot even agree as to whether those compounds are organic or mineral.

Landes, in *Petroleum Geology* (1951, p. 130) says:

Petroleum geologists have written more on the origin of petroleum than on any other subject. Speculation in this field was originated in the 1860's, and the problem of origin is still with us.

V. C. Illing, in *Geology of Petroleum* (p. 491) says: "Each year the crop of new papers adds to the fearsome pile, threatening to bury the subject by the very dead weight of diversified opinion. . . ." Landes expresses his own belief by saying:

There can be but little doubt that the carbon and hydrogen in petroleum and natural gas were, in their initial stages, like everything else on this Earth, in solution in hot liquid rock of magma.

According to the theory the reader and this writer have been exploring, is it not more probable that petroleum and other hydro-carbons were fused, volatilized and hurled to the skies by formative heat, to revolve with numberless other minerals in Earth's primordial atmosphere until they eventually descended, long after the "hot liquid magma" had cooled, to be accumulated among other compounds in Earth's supercrust?

Man Saw Primordial Clouds

There are intriguing implications relating to human experiences in the theory we have explored. We have pictured a world roofed by a rapidly revolving, turbulent, hurtling cloud cover thousands of miles above in space, composed of frozen water crystals, with which were intermingled, in greater or lesser percentages, condensed particles of other minerals. This cloud cover was pictured as being similar to those which now obscure the cores of Jupiter and other planets. We theorized that the clouds slowly lost velocity due to gravitational forces and therefore inevitably drew nearer to Earth; that retardation progressed until eventually centrifugal force, generated by revolution, no longer balanced centripetal force of Earth's gravity. We reasoned that such retardation could not progress equally throughout the clouds to the point where gravity would simultaneously triumph over the entire mass. We concluded that portions of the clouds lingered in space and did not descend to Earth until very recently. We reasoned that in some instances increments of water and other minerals in the clouds naturally must have descended in cataclysmic, destructive deluges. We concluded that such deluges account for sudden, violent changes in nature, which so evidently have occurred, with accompanying abrupt termination of various geological ages.

That ancient mankind actually saw lingering portions of those cloud canopies hurtling in space far above him, witnessed and endured the fall of increments thereof, is decisively indicated by the religions, the traditions, the superstitions, the folklore of every race of mankind on Earth. This thought may be startling to geologists, archaeologists, paleontologists, geomorphologists, etc., who are accustomed to believe that present conditions on Earth have endured for millions of years, but evidence to support the thought is voluminous and decisive.

Collectively, experiences indelibly impressed in the memory of man indicate that global catastrophes occurred and continued into historical times. Quotations to prove the point from tradi-

tions of ancient races would fill a book. Velikovsky, in *Worlds in Collision* and *Earth in Upheaval*, has gathered literally hundreds of such quotations gleaned from traditions and folklore of peoples all over the globe. Our own Bible can supply many such quotations. However, Velikovsky ascribes an entirely different cause to the phenomenon of catastrophes. He believes that they were caused by numerous collisions between the Earth and comets, with weird and fantastic results, including great changes in the tilt of Earth's axis, momentary stoppages in rotation of the Earth, and whip-lashing of ocean waters over the continents. Based upon mathematical computations and observation of their effect upon planets as they pass closely, it is generally believed that the mass of comets is much too small to effect such results, even if it could be believed that collisions did occur. Some astronomers have said that cometary mass is the nearest thing to nothing which can exist and yet be visible!

Racial Traditions

Records of what primitive man saw and endured are amazingly similar, world-wide, in spite of the fact that they were handed down only by word of mouth for hundreds or thousands of years in all races—races separated and isolated from each other by wide expanses of ocean waters. As primitive man could get but occasional, dim glimpses of Sun, Moon and stars through those turbulent, rushing clouds, is it any wonder that he conjured up the host of gods and superstitions which fill the records he has left? Is it any wonder that he added considerable imagination and exaggeration as he repeated the accounts over the centuries? Evidence is convincing that increments of primitive atmospheric substances fell to Earth long after man evolved and even in very recent geologic times. Hence we are confident that it cannot be fiction alone which inspired accounts of collapsing skies, catastrophic floods, titanic tempests, "hails" of "fiery stones from Heaven," streams of hot naphtha, showers of red ferruginous dust, of "a sticky substance" (bitumen) raining from the skies—stories which record cataclysmic

violence, destruction, darkness, terror, death! Is it any wonder that primitive man ascribed such catastrophes to the wrath of the gods?

Noah's Flood

Perhaps the most convincing, certainly the best known tradition indicating that man witnessed the fall of one of the last, if not the very last, increment of primordial atmosphere, is contained in our own Bible. However, stories with the identical theme are contained in the religions and folklore of all races of mankind, from the aborigines of Australia to the Eskimos of the Arctic; from the Aztecs to the very ancient Chinese. The story is the account in Genesis of the Noachian flood. This biblical account takes on a new and very real meaning in the light of our theory. It proves that, without doubt, a revolving canopy of cloud water was seen so recently by man as to have been indelibly stamped in his memory.

Statements that God made "a firmament in the midst of the waters and let it divide the waters from the waters"; that the waters "which were under the firmament" and "which were gathered together" to make the seas were divided "from the waters which were above the firmament" certainly have an absolutely definite meaning which our theory makes perfectly clear. The biblical account vividly describes the deluge which resulted when "the windows of Heaven were opened," when the waters "were increased greatly upon the Earth" and the rain fell in a great, cataclysmic deluge, destroying almost all land life on Earth. The sudden, calamitous nature of the catastrophe is accentuated throughout the story. Very evidently, the source of that terrific deluge was decidedly different from the puny collections of cloud moisture which come from mere evaporation of surface water. Not the least meaningful of the above biblical statements is that the waters "were increased greatly upon the Earth."

The Bible definitely records the fact that Noah's flood came from the last remnant of primordial water, for God said to Noah, "I will establish my covenant with you; neither shall

all flesh be cut off any more by the waters of a flood; neither shall there any more be a flood to destroy the Earth." And God said,

I do set my bow (rainbow*) in the cloud and it shall be for a token of a covenant between me and the Earth. . . . And I will remember my covenant, which is between me and you and every living creature of all flesh; and the waters shall no more become a flood to destroy all flesh.

Man knew there could never be another flood, for he had seen the last of the "waters above the firmament" descend and the sky was clear at long last! Would it be possible for language to corroborate our theory more plainly? Quite aside from any religious connotation, the above quotations constitute amazing bits of evidence to add to all that has been cited before. Surprisingly enough, although this story was handed down by word of mouth for hundreds of years before writing was invented, it has retained historical validity.

Men of narrow, cynical minds may say the biblical story of a flood is nothing but a fanciful Sumerian tale. How do they know? Aside from pure assumption, based solely upon imagination, they can produce no evidence whatsoever to support such a statement. On the other hand, evidence to sustain validity of the biblical story is plainly visible not only throughout the whole world, but in the heavens as well. Furthermore, the story is by no means exclusively Sumerian. It exists in the traditions of nations throughout the world—nations some of whom never heard of the Sumerians. One need not accept the biblical story as God-given to recognize that its truth is attested by much actual evidence.

* Rainbows could not have formed and been seen until after the sky was cleared of the primordial shroud and the Sun was exposed.

Conclusion

For more than one hundred years since Agassiz first showed that ice ages have occurred, countless students of glacial mysteries, right down to the present day, all pursuing persistently and clinging without deviation to two concepts only, have tried in vain to solve the riddle of ice ages. As has been noted, the two concepts are: that refrigeration of climate was the cause and evaporated surface water was the source of the ice.

These students have learned much about the nature, the behavior and the effects of the ice sheets; but they are positively no nearer to discovery of their origin than was Agassiz! Surely, therefore, they must have been pursuing the wrong basic concepts. While behavior and effects are interesting, certainly cause is far more important. Yet so little attention is paid to cause that a typical book of four hundred or more pages about glacial periods will contain perhaps but twenty pages devoted to cause! Actually, not one theory of cause, as such, will be offered in those twenty pages. The twenty pages will be devoted entirely to an effort to imagine conditions which would result in refrigeration of climate. That colder climate, per se, was the cause of ice ages, has just thoughtlessly and universally been taken for granted!

The unique theory which has been sketched herein is based upon entirely different conceptions. The author is convinced that it is the only one which, in more than one hundred years, has disclosed a competent force, combined with an adequate source, to supply the inconceivably vast amount of water involved in an ice age. The theory derives its great strength not alone from support given by well-known laws of nature, but also from even more convincing visible testimony supplied by the planets.

The author fully realizes how difficult it is to obtain thoughtful consideration, much less acceptance, of a new idea. He realizes that the theory herein expounded is so startlingly new and different from orthodox teachings, it may immediately elicit vio-

lent opposition. Nevertheless, those who would refute it must dispose of much corroborative planetary testimony and also conclusions which are based solidly upon that potent evidence.

The basic principles alone of the theory are important; not this writer's poor efforts to develop them. That they are not sound and true cannot be proved by picking out here and there miscellaneous assumptions, deductions and statements which have been made herein and demonstrating that they are erroneous. Neither can the theory be discredited because it is unorthodox, for all orthodox theories have long since been definitely, decisively and repeatedly rejected by leading authorities in the field. For the latter reason, students of glacial and other geological phenomena should heartily welcome this fresh theory to ponder.

As the reader reaches the close of this presentation he is therefore urged to keep foremost in mind the two illuminating, all-important, basic conceptions of the theory, to wit; first, that terrific, implacable heat—far, far more intense than mere solar heat received by Earth—was absolutely necessary to set the stage for a glacial age; and second, that the frozen moisture which built ice sheets in some areas and the liquid water which made pluvial conditions elsewhere were not evaporated surface water, but primitive, virgin water—water which was falling to Earth's surface for the first time; water which was responsible for increases in Earth's hydrosphere—increases which so very evidently have occurred from time to time since the first descending increments, far, far back in pregeological eras, were permitted to remain upon the slowly cooling crust.

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