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THE MARINE-LIFE ERA ON URANTIA

WE RECKON the history of Urantia as beginning about one billion years ago and extending through five major eras:

1. *The prelife era* extends over the initial four hundred and fifty million years, from about the time the planet attained its present size to the time of life establishment. Your students have designated this period as the *Archeozoic*.

2. *The life-dawn era* extends over the next one hundred and fifty million years. This epoch intervenes between the preceding prelife or cataclysmic age and the following period of more highly developed marine life. This era is known to your researchers as the *Proterozoic*.

3. *The marine-life era* covers the next two hundred and fifty million years and is best known to you as the *Paleozoic*.

4. *The early land-life era* extends over the next one hundred million years and is known as the *Mesozoic*.

5. *The mammalian era* occupies the last fifty million years. This recent-times era is known as the *Cenozoic*.

The marine-life era thus covers about one quarter of your planetary history. It may be subdivided into six long periods, each

POGLAVLJE 59

ERA MORSKOG ŽIVOTA NA URANTIJI

NAVODIMO povijest Urantije s početkom prije nekih milijardu godina kroz pet velikih razdoblja:

1. *Razdoblje prije početka života* proteže se tijekom početnih 450 milijuna godina, od vremena kad planet postiže svoju današnju veličinu do osnutka života. Vaši studenti označavaju ovo razdoblje kao *arheozoik*.

2. *Razdoblje početka života* traje kroz idućih 150 milijuna godina. Ova epoha intervenira između ranije predživotne ili kataklizmičke dobi i kasnijeg razdoblja naprednijeg života u moru. To razdoblje je poznato vašim istraživačima kao *proterozoic*.

3. *Era morskog života* pokriva sljedećih 250 milijuna godina, a poznatija je vama kao *paleocen*.

4. *Razdoblje ranog kopnenog života* proteže se kroz idućih 100 milijuna godina, a poznato je kao *mezozoik*.

5. *Razdoblje sisavaca* zauzima posljednjih 50 milijuna godina. Ovo skorije razdoblje poznato je kao *kenozoik*.

Era morskog života zauzima otprilike četvrtinu vaše planetarne povijesti. Može se podijeliti u šest dugih razdoblja, svaka

characterized by certain well-defined developments in both the geologic realms and the biologic domains.

As this era begins, the sea bottoms, the extensive continental shelves, and the numerous shallow near-shore basins are covered with prolific vegetation. The more simple and primitive forms of animal life have already developed from preceding vegetable organisms, and the early animal organisms have gradually made their way along the extensive coast lines of the various land masses until the many inland seas are teeming with primitive marine life. Since so few of these early organisms had shells, not many have been preserved as fossils. Nevertheless the stage is set for the opening chapters of that great "stone book" of the life-record preservation which was so methodically laid down during the succeeding ages.

The continent of North America is wonderfully rich in the fossil-bearing deposits of the entire marine-life era. The very first and oldest layers are separated from the later strata of the preceding period by extensive erosion deposits which clearly segregate these two stages of planetary development.

od kojih se svako odlikuje određenim jasno definiranim zbivanjima kako u području geoloških tako i u području bioloških domena.

Na početku ove dobi, morsko dno, široke kontinentalne ravni i brojni plitki priobalni bazeni prekriveni su plodnom vegetacijom. Jednostavniji i primitivniji oblici životinjskog svijeta već su se razvili od ranijih biljnih organizama, a rani životinjski organizmi postupno prelaze na obale diljem dugih obala kopna, dok mnoga unutrašnja mora vrve primitivnim oblicima morskog života. Budući da su među tim ranim organizmima bile rijetke zaštitne ljuske, nije ih mnogo očuvano u obliku fosila. No unatoč time, pripravljena je pozornica za otvaranje prvih poglavlja te velike "kamene knjige" životnog zapisa koja je tako metodički zabilježena i očuvana u narednim dobima.

Kontinent Sjeverne Amerike bio je nevjerojatno bogat u fosilnim depozitima tijekom cijelog razdoblja morskog života. Prvi i najstariji slojevi odvojeni su od slojeva iz kasnijih dobi zahvaljujući snažnom djelovanju erozijskih depozita koji su jasno razdvojili ove dvije faze planetarnog razvoja.

EARLY MARINE LIFE IN THE SHALLOW SEAS -- THE TRILOBITE AGE

By the dawn of this period of relative quiet on the earth's surface, life is confined to the various inland seas and the oceanic shore line; as yet no form of land organism has evolved. Primitive marine animals are well established and are prepared for the next evolutionary development. Amebas are typical survivors of this initial stage of animal life, having made their appearance toward the close of the preceding transition period.

400,000,000 years ago marine life, both vegetable and animal, is fairly well distributed over the whole world. The world climate grows slightly warmer and becomes more equable. There is a general inundation of the seashores of the various continents, particularly of North and South America. New oceans appear, and the older bodies of water are greatly enlarged.

Vegetation now for the first time crawls out upon the land and soon makes considerable progress in adaptation to a nonmarine habitat.

Suddenly and without gradation ancestry the first multicellular animals make their appearance. The trilobites have evolved, and for ages they dominate the seas. From the standpoint of marine life this is the trilobite age.

RANI MORSKI ŽIVOT U PLITKIM MORIMA – RAZDOBLJE TRILOBITA

Na početku ovog razdoblja relativnog mira na površini Zemlje, život je ograničen na različita unutarnja mora i oceansko kopno; još nije evoluirao niti jedan oblik kopnenog života. Primitivne morske životinje dobro su formirane i spremne za sljedeći stadij evolucijskog razvoja. Amebe su tipični oblik života iz te početne faze životinjskog svijeta, a pojavile su se pred kraj prethodnog prijelaznog razdoblja.

Prije 400 milijuna godina život u moru, kako biljni tako i životinjski, prilično se dobro rasprostranio po cijelom svijetu. Širom svijeta klima postaje malo toplija i ujednačenija. Dolazi do općeg plavljenja obala raznih kontinenata, naročito Sjeverne i Južne Amerike. Javljaju se novi oceani i bitno se uvećavaju starije vodene jedinice.

Vegetacija po prvi put prelazi na kopno i uskoro postiže znatan napredak u procesu prilagodbe na kopnena staništa.

Iznenada i bez gradacija javljaju se preci prvih višestaničnih životinja. Javljaju se trilobiti koji kroz mnoge dobi dominiraju morima. Sa stajališta morskog života, ovo je razdoblje trilobita.

In the later portion of this time segment much of North America and Europe emerged from the sea. The crust of the earth was temporarily stabilized; mountains, or rather high elevations of land, rose along the Atlantic and Pacific coasts, over the West Indies, and in southern Europe. The entire Caribbean region was highly elevated.

390,000,000 years ago the land was still elevated. Over parts of eastern and western America and western Europe may be found the stone strata laid down during these times, and these are the oldest rocks which contain trilobite fossils. There were many long fingerlike gulfs projecting into the land masses in which were deposited these fossil-bearing rocks.

Within a few million years the Pacific Ocean began to invade the American continents. The sinking of the land was principally due to crustal adjustment, although the lateral land spread, or continental creep, was also a factor.

380,000,000 years ago Asia was subsiding, and all other continents were experiencing a short-lived emergence. But as this epoch progressed, the newly appearing Atlantic Ocean made extensive inroads on all adjacent coast lines. The northern Atlantic or Arctic seas were then connected with the southern Gulf waters. When this southern sea entered the Appalachian trough, its waves broke upon the east against mountains as high as the Alps,

U kasnijem dijelu ove vremenske dobi iz mora izranja veći dio Sjeverne Amerike i Europe. Privremeno se stabilizira zemljina kora; planine, ili bolje rečeno visoka uzvisja, rastu duž obala Atlanskog i Tihog oceana, preko zapadne Indije i na jugu Europe. Visoko se uzdiže cijelo područje Kariba.

Prije 390 milijuna godina zemlja je još uvijek povišena. U dijelovima istočne i zapadne Amerike i zapadne Europe može se naći kameni sloj formiran tijekom tog vremena, a to su najstarije stijene koje sadrže fosile trilobita. Bilo je mnogo dugih prstastih zaljeva duboko zavučenih unutar kopna u kojima su se deponirale te fosilne stijene.

U roku od nekoliko milijuna godina, Tihi ocean je počeo ispunjati američke kontinente. Do potapanja zemljišta prvenstveno je dolazilo usred prilagodbe zemljine kore, premda je lateralno proširenje kopna, takozvano kontinentalno istezanje, također bilo faktor.

Prije 380 milijuna godina Azia je ponirala, dok su svi drugi kontinenti prolazili kratkotrajnim procesom uzvišenja. No s napretkom ove epohe, novostvoreni Atlantski ocean obilno se uvukao u obalne linije kopna. Sjeverno Atlantsko ili Arktičko more zatim se povezalo s vodama južnog Meksičkog zaljeva. Kada je to južno more ušlo u Apalačansko korito, njegovi su se valovi na istoku razbijali o planine koje su imale visinu Alpa, dok su

but in general the continents were uninteresting lowlands, utterly devoid of scenic beauty.

The sedimentary deposits of these ages are of four sorts:

1. Conglomerates — matter deposited near the shore lines.
2. Sandstones — deposits made in shallow water but where the waves were sufficient to prevent mud settling.
3. Shales — deposits made in the deeper and more quiet water.
4. Limestone — including the deposits of trilobite shells in deep water.

The trilobite fossils of these times present certain basic uniformities coupled with certain well-marked variations. The early animals developing from the three original life implantations were characteristic; those appearing in the Western Hemisphere were slightly different from those of the Eurasian group and from the Australasian or Australian-Antarctic type.

370,000,000 years ago the great and almost total submergence of North and South America occurred, followed by the sinking of Africa and Australia. Only certain parts of North America remained above these shallow Cambrian seas. Five million years later the seas were retreating before the rising land. And all of these phenomena of land sinking and land rising were undramatic, taking place slowly over millions of years.

kontinenti uopćeno bili nezanimljive nizine, lišene bilo kakve ljepote.

Sedimentne naslage tih dobi dijele se u četiri vrste:

- 1 . Konglomerate - tvari pohranjene blizu obalne linije.
- 2 . Pješčenjake - depozite izrađene u plitkoj vodi, ali gdje su valovi bili dovoljni da se spriječi taloženje blata.
- 3 . Škriljce - depozite izrađene u dubljim i mirnijim vodama.
- 4 . Vapnence - uključujući i depozite trilobitnih školjki u dubokoj vodi.

Trilobitni fosili iz ovih vremena svjedoče o određenim bitnim jednolikostima u kombinaciji s određenim jasnim varijacijama. Jasno se mogu uočiti razlike u ranim životinjama koje potiču iz triju izvornih implantacija života; one koje se javljaju u zapadnoj hemisferi pomalo se razlikuju od Euroazijske grupe i od Australazijskog ili Australsko-Antarktičkog tipa.

Prije 370 milijuna godina došlo je do velikog i gotovo posvemašnjeg potapanja Sjeverne i Južne Amerike, praćenog potonućem Afrike i Australije. Jedino su određeni dijelovi Sjeverne Amerike ostali iznad tih plitkih kambrijskih mora. Pet milijuna godina kasnije, mora se povlače usljed uzdizanja kopna. I sve ove pojave kopnenog potapanja i uzdizanja nisu bile dramatske, već su se odigrale korak po korak tijekom više milijuna godina.

The trilobite fossil-bearing strata of this epoch outcrop here and there throughout all the continents except in central Asia. In many regions these rocks are horizontal, but in the mountains they are tilted and distorted because of pressure and folding. And such pressure has, in many places, changed the original character of these deposits. Sandstone has been turned into quartz, shale has been changed to slate, while limestone has been converted into marble.

360,000,000 years ago the land was still rising. North and South America were well up. Western Europe and the British Isles were emerging, except parts of Wales, which were deeply submerged. There were no great ice sheets during these ages. The supposed glacial deposits appearing in connection with these strata in Europe, Africa, China, and Australia are due to isolated mountain glaciers or to the displacement of glacial debris of later origin. The world climate was oceanic, not continental. The southern seas were warmer then than now, and they extended northward over North America up to the polar regions. The Gulf Stream coursed over the central portion of North America, being deflected eastward to bathe and warm the shores of Greenland, making that now ice-mantled continent a veritable tropic paradise.

The marine life was much alike the world over and consisted of the seaweeds, one-celled organisms, simple sponges, trilobites, and other crustaceans — shrimps, crabs, and lobsters. Three

Trilobitni fosilni slojevi tog razdoblja pojavili su se na površini tu i tamo po svim kontinentima osim u središnjoj Aziji. U mnogim područjima ove stijene su horizontalne, dok su u planinama nakrivljene i izobličene zbog pritiska i slaganja. I taj je pritisak, na mnogim mjestima, promijenio izvorni karakter tih depozita. Pješčenjak je pretvoren u kvarc, škriljac je promijenjen u lisnac, dok je vapnenac pretvoren u mramor.

Prije 360 milijuna godina kopno se još uvijek uzdizalo. Visoko su uzdignute Sjeverna i Južna Amerika. Iz mora su se pojavile Zapadna Europa i Britanski otoci, osim dijelova Velsa, koji su još uvijek bili duboko potopljani. Tijekom tih razdoblja nije bilo velikih ledenih ploča. Takozvani ledeni depoziti koji su se pojavili u vezi s tim slojevima u Europi, Africi, Kini i Australiji predstavljaju rezultat djelovanja izoliranih planinskih ledenjaka ili razmicanja kasnijih ledenih krhotina. Svjetska klima je bila oceanska, a ne kontinentalna. Južna mora su bila toplija nego što su sada, a širila su se prema sjeveru preko Sjeverne Amerike do polarnih regija. Golfska struja je tekla preko središnjeg dijela Sjeverne Amerike, skrećući prema istoku da okupa i zagrije obale Grenlanda, što je pretvorilo ovaj kontinent danas prekriven ledom u pravi tropski raj.

Morski svijet je bio uveliko ujednačen širom svijeta, a sastojao se od algi, jednostaničnih organizama, jednostavnih spužvi, trilobita i drugih ljuskara - škampa, rakova i jastoga. Javile su se tri

thousand varieties of brachiopods appeared at the close of this period, only two hundred of which have survived. These animals represent a variety of early life which has come down to the present time practically unchanged.

But the trilobites were the dominant living creatures. They were sexed animals and existed in many forms; being poor swimmers, they sluggishly floated in the water or crawled along the sea bottoms, curling up in self-protection when attacked by their later appearing enemies. They grew in length from two inches to one foot and developed into four distinct groups: carnivorous, herbivorous, omnivorous, and “mud eaters.” The ability of the latter group largely to subsist on inorganic matter — being the last multicelled animal that could — explains their great increase and long survival.

This was the biogeologic picture of Urantia at the end of that long period of the world’s history, embracing fifty million years, designated by your geologists as the *Cambrian*.

2. THE FIRST CONTINENTAL FLOOD STAGE – THE INVERTEBRATE-ANIMAL AGE

The periodic phenomena of land elevation and land sinking characteristic of these times were all gradual and nonspectacular, being accompanied by little or no volcanic action. Throughout all of these successive land elevations and depressions the

tisuće vrsta brahiopoda pred kraj tog razdoblja, od kojih su samo dvije stotine preživjele. Ove životinje predstavljaju oblik ranog života koji se održao do danas gotovo posve nepromijenjen.

Trilobiti su bili dominantni oblik života. Bile su to spolne životinje koje su postojale u mnogim oblicima; bili su loši plivači koji su tromo plutali u vodi ili puzali po morskom dnu, uvijali se u samozaštiti pri napadu svojih kasnijih neprijatelja. Rasli su u duljini od pet do trideset centimetara, a razvili su se u četiri različite skupine: mesoždere, biljojede, svezede i “blatojede.” Sposobnost ove posljednje grupe da opstane na neorganskoj tvari – posljednja višestanična životinja s ovom sposobnošću - objašnjava njihovo brzo umnožavanje i dugi opstanak.

To je bila geološka slika Urantije na kraju tog dugog razdoblja svjetske povijesti koje obuhvaća nekih 50 milijuna godina, a koje vaši geolozi nazivaju *kambrij*.

2 . STADIJ PRVOG KONTINENTALNOG POTOPA – DOBA BESKRALJEŠNJAKA

Naizmjenično uzvišenje i potapanje kopnenih masa koje obilježava ovo razdoblje bilo je postupno i nespektakularno, praćeno s malo ili ni malo vulkanskog djelovanja. Kroz cijeli ovaj slijed uzastopnih povišenja i depresija, majčinski

Asiatic mother continent did not fully share the history of the other land bodies. It experienced many inundations, dipping first in one direction and then another, more particularly in its earlier history, but it does not present the uniform rock deposits which may be discovered on the other continents. In recent ages Asia has been the most stable of all the land masses.

350,000,000 years ago saw the beginning of the great flood period of all the continents except central Asia. The land masses were repeatedly covered with water; only the coastal highlands remained above these shallow but widespread oscillatory inland seas. Three major inundations characterized this period, but before it ended, the continents again arose, the total land emergence being fifteen per cent greater than now exists. The Caribbean region was highly elevated. This period is not well marked off in Europe because the land fluctuations were less, while the volcanic action was more persistent.

340,000,000 years ago there occurred another extensive land sinking except in Asia and Australia. The waters of the world's oceans were generally commingled. This was a great limestone age, much of its stone being laid down by lime-secreting algae.

A few million years later large portions of the American continents and Europe began to emerge from the water. In the Western Hemisphere

kontinent Azije nije prošao kroz povijest drugih kopnenih tijela. Doživio je mnoge poplave, porinući prvo u jednom smjeru a zatim u drugom, posebno u svojoj ranijoj povijesti, ali on nije izgrađen od jednoličnih stjenovitih depozita koji se mogu naći na drugim kontinentima. U posljednjih nekoliko skorijih razdoblja Azija je bila stabilnija od svih drugih kopnenih masa.

Prije 350 milijuna godina nastupio je početak velikog razdoblja poplava na svim kontinentima osim središnje Azije. Zemljišne mase su više puta bile nanovo preplavljene vodom, dok su jedino obalne visoravni ostale iznad plitkih, ali raširenih oscilatornih unutarnjih mora. Tri velike poplave obilježavaju ovo razdoblje, ali prije njegova svršetka, kontinenti su se iznova izdigli, a ukupna kopnena masa je bila nekih petnaest posto veća od današnje. Karibi su bili znatno uzvišeni. To razdoblje nije bitnije obilježeno u Europi gdje su oscilacije zemljišta bile manje, dok je vulkanska aktivnost bila ustrajnija.

Prije 340 milijuna godina dogodilo se još jedno veliko potonuće kopna po cijelom svijetu osim Azije i Australije. Vode svjetskih oceana uglavnom su bile pomiješane. Nastupilo je veliko doba vapnenca, a veći dio ovog vapna predstavlja izlučevinu algi.

Nekoliko milijuna godina kasnije, veliki dijelovi Američkih kontinenata i Europe počeli su izranjati iz vode. U zapadnoj hemisferi jedino je

only an arm of the Pacific Ocean remained over Mexico and the present Rocky Mountain regions, but near the close of this epoch the Atlantic and Pacific coasts again began to sink.

330,000,000 years ago marks the beginning of a time sector of comparative quiet all over the world, with much land again above water. The only exception to this reign of terrestrial quiet was the eruption of the great North American volcano of eastern Kentucky, one of the greatest single volcanic activities the world has ever known. The ashes of this volcano covered five hundred square miles to a depth of from fifteen to twenty feet.

320,000,000 years ago the third major flood of this period occurred. The waters of this inundation covered all the land submerged by the preceding deluge, while extending farther in many directions all over the Americas and Europe. Eastern North America and western Europe were from 10,000 to 15,000 feet under water.

310,000,000 years ago the land masses of the world were again well up excepting the southern parts of North America. Mexico emerged, thus creating the Gulf Sea, which has ever since maintained its identity.

The life of this period continues to evolve. The world is once again quiet and relatively peaceful; the climate remains mild and equable; the land plants are migrating farther and farther from the seashores.

rukavac Tihog oceana ostao na području Meksika i sadašnjih Stjenjaka, ali pred kraj ove epohe počele su tonuti obale Atlantskog i Tihog oceana.

Prije 330 milijuna nastupa početak vremenskog razdoblja relativne tišine u cijelom svijetu, s puno zemlje ponovno iznad vode. Jedini izuzetak od te zemaljske tišine bila je erupcija velikog vulkana Sjeverne Amerike u istočnom Kentakiju, jedna od najvećih pojedinačnih vulkanskih aktivnosti koju je svijet imao priliku upoznati. Pepeo ovog vulkana depozitiran je na području od tisuću tri stotine kvadratnih kilometara, u visini pet do šest metara.

Prije 320 milijuna godina dolazi do trećeg velikog potopa iz tog razdoblja. Vode ovog potopa prekrile su svo kopno koje je i prije bilo potopljeno, dok se voda proširila još dalje u mnogim smjerovima diljem Amerike i Europe. Istočni dio Sjeverne Amerike i zapadna Europa ležale su 3,000 do 4,000 metara ispod vode.

Prije 310 milijuna godina ponovo su uzdignute kopnene mase izuzev južnog dijela Sjeverne Amerike. Pojavio se Meksiko, tako stvarajući Meksički zaljev, koji je sve do danas zadržao identitet.

Život se u tom razdoblju nastavlja razvijati. Svijet ponovo postiže mir i relativan spokoj; klima je blaga i ujednačena; kopnene biljke se sele sve dalje i dalje od obala mora. Životni uzorci su već

The life patterns are well developed, although few plant fossils of these times are to be found.

This was the great age of individual animal organismal evolution, though many of the basic changes, such as the transition from plant to animal, had previously occurred. The marine fauna developed to the point where every type of life below the vertebrate scale was represented in the fossils of those rocks which were laid down during these times. But all of these animals were marine organisms. No land animals had yet appeared except a few types of worms which burrowed along the seashores, nor had the land plants yet overspread the continents; there was still too much carbon dioxide in the air to permit of the existence of air breathers. Primarily, all animals except certain of the more primitive ones are directly or indirectly dependent on plant life for their existence.

The trilobites were still prominent. These little animals existed in tens of thousands of patterns and were the predecessors of modern crustaceans. Some of the trilobites had from twenty-five to four thousand tiny eyelets; others had aborted eyes. As this period closed, the trilobites shared domination of the seas with several other forms of invertebrate life. But they utterly perished during the beginning of the next period.

Lime-secreting algae were widespread. There existed thousands of species of the early

dobro razvijeni, premda se iz ovog razdoblja može naći mali broj biljnih fosila.

Bila je to velika era evolucije individualnih životinjskih organizama, premda su se već odigrale mnoge temeljne promjene, kao što je prijelaz vegetativnog svijeta u životinjski. Morska fauna se razvija do točke na kojoj je svaki tip života ispod kralježnjaka zastupljen u fosilima stijena koje su formirane tijekom tog vremena. No, sve su to jedino morske životinje. Još se nije pojavio ni jedan oblik kopnenih životinja osim nekoliko vrsta crva koji su živjeli u obalnim udubinama, niti su se po kontinentima još proširile kopnene biljke; u zraku je još uvijek bilo previše ugljičnog dioksida kako bi se omogućilo postojanje bića koja ovise o kisiku. Isprva, egzistencija svih životinja osim nekih primitivnih izravno ili neizravno ovisi o biljnom svijetu.

Trilobiti još uvijek vladaju svijetom. Te su male životinje postojale u desecima tisuća uzoraka i bile su prethodnici modernih rakova. Neki trilobiti su imali od dvadeset pet do četiri tisuće sitnih očiju; drugi su imali spoljašnje oči. Pri svršetku ovog razdoblja, trilobiti su dijelili dominaciju nad morima s nekoliko drugih beskralježnjaka. Ali oni posve nestaju s lica zemlje na početku sljedeće dobi.

Svijetom su se raširile alge koje luče vapnenac. Postojalo je više tisuća vrsta ranih

ancestors of the corals. Sea worms were abundant, and there were many varieties of jellyfish which have since become extinct. Corals and the later types of sponges evolved. The cephalopods were well developed, and they have survived as the modern pearly nautilus, octopus, cuttlefish, and squid.

There were many varieties of shell animals, but their shells were not then so much needed for defensive purposes as in subsequent ages. The gastropods were present in the waters of the ancient seas, and they included single-shelled drills, periwinkles, and snails. The bivalve gastropods have come on down through the intervening millions of years much as they then existed and embrace the mussels, clams, oysters, and scallops. The valve-shelled organisms also evolved, and these brachiopods lived in those ancient waters much as they exist today; they even had hinged, notched, and other sorts of protective arrangements of their valves.

So ends the evolutionary story of the second great period of marine life, which is known to your geologists as the *Ordovician*.

3. THE SECOND GREAT FLOOD STAGE THE CORAL PERIOD – THE BRACHIOPOD AGE

300,000,000 years ago another great period of land submergence began. The southward and northward encroachment of the ancient Silurian

predaka koralja. Morski crvi su postojali u izobilju, a bilo je i više vrsta meduza koje su kasnije izumrle. Evoluirali su koralji i kasniji tipovi spužvi. Dobro su se razvili glavonošci, koji su preživjeli do danas kao moderni biserni nautilus, hobotnica, sipa i lignje.

Bilo je i mnogo vrsta ljuskastih životinja, ali njihove ljuske još nisu bile toliko bitne u obrambene svrhe kako će to biti u kasnijim dobima. Puževi su bili prisutni u vodama drevnih mora, a oni uključuju jednoljuskaste bušilice, spirale i puževe. Bivalvularni gastropodi se spuštaju kroz dugi niz milijuna godina u više-manje nepromijenjenom obliku i u njih se ubrajaju dagnje, školjke, kamenice i Jakobove kapice. Ventiloljuskasti organizmi su također evoluirali i ti su brahiopodi živjeli u drevnim vodama onakvi kakvi i danas postoje; štoviše su imali nareckane, urezane i na druge načine aranžirane zaštitne valve.

Tako završava evolucijska saga drugog velikog razdoblja u razvoju morskog života, koji je među geolozima poznat kao *ordovicij*.

3. DRUGI VELIKI STADIJ POTOPA – DOBA KORALA – RAZDOBLJE BRAHIPODA

Prije 300 milijuna godina započelo je još jedno veliko razdoblje potopa. Južni i sjeverni rukavci drevnog Silurskog mora spremali su se

seas made ready to engulf most of Europe and North America. The land was not elevated far above the sea so that not much deposition occurred about the shore lines. The seas teemed with lime-shelled life, and the falling of these shells to the sea bottom gradually built up very thick layers of limestone. This is the first widespread limestone deposit, and it covers practically all of Europe and North America but only appears at the earth's surface in a few places. The thickness of this ancient rock layer averages about one thousand feet, but many of these deposits have since been greatly deformed by tilting, upheavals, and faulting, and many have been changed to quartz, shale, and marble.

No fire rocks or lava are found in the stone layers of this period except those of the great volcanoes of southern Europe and eastern Maine and the lava flows of Quebec. Volcanic action was largely past. This was the height of great water deposition; there was little or no mountain building.

290,000,000 years ago the sea had largely withdrawn from the continents, and the bottoms of the surrounding oceans were sinking. The land masses were little changed until they were again submerged. The early mountain movements of all the continents were beginning, and the greatest of these crustal upheavals were the Himalayas of Asia and the great Caledonian Mountains, extending from Ireland through Scotland and on to Spitzbergen.

progutati veći dio Europe i Sjeverne Amerike. Kopno nije bilo puno više od mora, tako da nije došlo do većeg taloženja duž obala. Mora su obilovala vapneno-ljuskastim oblicima života i depositiranjem tih ljuski na dnu mora postupno su formirani debeli slojevi vapnenca. Bio je to prvi široko rasprostranjeni depozit vapnenca na području gotovo cijele Europe i Sjeverne Amerike, dok se na površini javlja tek na nekoliko mjesta. Debljina tog drevnog sloja stijena u prosjeku iznosi oko tri stotine metara, dok su mnogi depoziti kasnije bitno deformirani nagibanjem, potresima i rasjedima, a mnogi su promijenjeni u kvarc, škriljavec i mramor.

U kamenim slojevima tog razdoblja ne mogu se naći stijene izgrađene od vatre i lave, osim na području velikih vulkana južne Europe, istočne države Main i Quebeca. Vulkansko je djelovanje u velikoj mjeri stvar prošlosti. Ovo je razdoblje obilježeno velikim depozitima na dnu mora; bilo je malo ili nimalo formiranja planina.

Prije 290 milijuna godina mora su se uglavnom povukla sa površine kontinenata, dok se dno okolnih oceana nastavilo spuštati. Kopnene mase su se malo promijenile dok se opet nisu našle potopljene. Sada započinju rani pokreti koji vode formiranju planina na svim kontinentima, a najveći preokreti zemljine kore bili su na Himalajima u Aziji i velikim Kaledonijskim planinama, protežući se od Irske kroz Škotsku i do Spitzbergena.

It is in the deposits of this age that much of the gas, oil, zinc, and lead are found, the gas and oil being derived from the enormous collections of vegetable and animal matter carried down at the time of the previous land submergence, while the mineral deposits represent the sedimentation of sluggish bodies of water. Many of the rock salt deposits belong to this period.

The trilobites rapidly declined, and the center of the stage was occupied by the larger mollusks, or cephalopods. These animals grew to be fifteen feet long and one foot in diameter and became masters of the seas. This species of animal appeared *suddenly* and assumed dominance of sea life.

The great volcanic activity of this age was in the European sector. Not in millions upon millions of years had such violent and extensive volcanic eruptions occurred as now took place around the Mediterranean trough and especially in the neighborhood of the British Isles. This lava flow over the British Isles region today appears as alternate layers of lava and rock 25,000 feet thick. These rocks were laid down by the intermittent lava flows which spread out over a shallow sea bed, thus interspersing the rock deposits, and all of this was subsequently elevated high above the sea. Violent earthquakes took place in northern Europe, notably in Scotland.

U depozitima tog doba nalazi se mnogo plina, nafte, cinka i olova, dok su plin i nafta biti izvedeni iz golemih zbirki biljne i životinjske materije koja je nataložena tijekom prethodnog potopa, dok mineralni depoziti predstavljaju rezultat taloženja u stajaćim vodama. Mnogi depoziti kamene soli pripadaju tom razdoblju.

Broj trilobita naglo opala, a na centar pozornice stupaju veći mekušci ili glavonožci. Ove su životinje rasle u duljinu od pet metara i promjer od trideset centimetara i postale su gospodarima mora. Ove vrste životinja javljaju se *iznenada* i preuzimaju dominaciju nad životom u moru.

Velika vulkanska aktivnost ove dobi događa se u europskom sektoru. Kroz milijune i milijune godina nije bilo tako nasilnih i opsežnih vulkanskih erupcija do kojih dolazi oko Sredozemnog korita, a posebno u susjedstvu Britanskog otočja. Ovaj tok lave iznad regije Britanskog otočja i danas se javlja u depozitima lave koji se smijenjuju sa slojevima stijena u širini od gotovo 8,000 metara. Ove stijene su nastale kao rezultat povremenih bujica lave koje su proticale preko plitkog morskog dna, tako da je došlo do stvaranja interspersnih depozita koji su se naknadno uzdigli visoko iznad površine mora. Nasilni potresi su se dogodili u sjevernoj Europi, a osobito u Škotskoj.

The oceanic climate remained mild and uniform, and the warm seas bathed the shores of the polar lands. Brachiopod and other marine-life fossils may be found in these deposits right up to the North Pole. Gastropods, brachiopods, sponges, and reef-making corals continued to increase.

The close of this epoch witnesses the second advance of the Silurian seas with another commingling of the waters of the southern and northern oceans. The cephalopods dominate marine life, while associated forms of life progressively develop and differentiate.

280,000,000 years ago the continents had largely emerged from the second Silurian inundation. The rock deposits of this submergence are known in North America as Niagara limestone because this is the stratum of rock over which Niagara Falls now flows. This layer of rock extends from the eastern mountains to the Mississippi valley region but not farther west except to the south. Several layers extend over Canada, portions of South America, Australia, and most of Europe, the average thickness of this Niagara series being about six hundred feet. Immediately overlying the Niagara deposit, in many regions may be found a collection of conglomerate, shale, and rock salt. This is the accumulation of secondary subsidences. This salt settled in great lagoons which were alternately opened up to the sea and then cut off so that evaporation occurred with deposition of salt along

Oceanska klima ostaje blaga i ujednačena, a toplo more okružuje obale polarnih krajeva. Brahiopodi i fosili drugih morskih životinja mogu se naći u tim depozitima sve do Sjevernog pola. Puževi, brahiopodi, spužve i grebeni koralji i dalje su u porastu.

Kraj ove epohe svjedoči drugim širenjem Silurskog mora pomiješanog s vodama južnih i sjevernih oceana. Glavonošci dominiraju morskim životom, dok se drugi s njima povezani oblici života nastavljaju razvijati i diferencirati.

Prije 280 milijuna godina kontinenti su se uglavnom uzdigli iz voda drugog Silurskog potopa. Stjenoviti depoziti ovog potopa poznati su u Sjevernoj Americi kao vapnenac Niagare, jer to je sloj stijena po kojima danas teče voda Niagare. Ovak se sloj stijena proteže od istočnih planina do doline Misisipija i dalje prema jugu, ali ne i prema zapadu. Nekoliko slojeva se protežu u Kanadu, dijelove Južne Amerike, Australije i većeg dijela Europe, a prosječna debljina ove Niagara serije iznosi oko dvije stotine metara. Neposredno povrh Niagara depozita, u mnogim se regijama mogu naći zbirke konglomerata, škriljevca i kamene soli. To je akumulacija sekundarnih slijeganja. Ova se sol taložila u velikim lagunama koje su se naizmjenično otvarale prema moru i bile odsječene od mora, tako da je došlo do isparavanja kao i novog taloženja soli i njezina miješanja s drugim tvarima koje su

with other matter held in solution. In some regions these rock salt beds are seventy feet thick.

The climate is even and mild, and marine fossils are laid down in the arctic regions. But by the end of this epoch the seas are so excessively salty that little life survives.

Toward the close of the final Silurian submergence there is a great increase in the echinoderms — the stone lilies — as is evidenced by the crinoid limestone deposits. The trilobites have nearly disappeared, and the mollusks continue monarchs of the seas; coral-reef formation increases greatly. During this age, in the more favorable locations the primitive water scorpions first evolve. Soon thereafter, and *suddenly*, the true scorpions — actual air breathers — make their appearance.

These developments terminate the third marine-life period, covering twenty-five million years and known to your researchers as the *Silurian*.

4. THE GREAT LAND-EMERGENCE STAGE THE VEGETATIVE LAND-LIFE PERIOD - THE AGE OF FISHES

In the age-long struggle between land and water, for long periods the sea has been comparatively victorious, but times of land victory are just ahead. And the continental drifts have not proceeded so far but that, at times, practically all of

se održale u slanoj otopini. U nekim su krajevima depoziti ove kamene soli široki preko dvadeset metara.

Klima je bila uravnotežena i blaga, a morski fosili su se taložili u arktičkim područjima. No, pred kraj ove epohe mora su postala toliko slana da je malo života uspjelo preživjeti.

Pred kraj završnog Silurskog potopa dolazi do velikog porasta u broju bodljikaša - kamenih ljiljana - što se očituje u crinoidnim naslagama vapnenca. Trilobiti su gotovo nestali, a mekušci i dalje vladaju morima; znatno se uvećavaju formacije koraljnih grebena. Tijekom ovog razdoblja, u povoljnijim su se lokacijama prvo javili primitivni vodeni škorpioni. Ubrzo nakon toga i *iznenada*, pojavili su se pravi škorpioni – koji su stvarno disali na pluća.

S ovakvim razvojem događaja dolazi do okončanja trećeg razdoblja morskog života, koji pokriva dvadeset pet milijuna godina i koji je među vašim istraživačima poznat kao *silur*.

4. VELIKO RAZDOBLJE KOPNENE FORMACIJE - VEGETATIVNI PERIOD U RAZVOJU ŽIVOTA – RAZDOBLJE RIBA

U vjekovnoj borbi između kopna i mora, more je dugo nosilo relativnu pobjedu, ali sada predstoji vrijeme kopnene pobjede. A kontinentalna pomicanja nisu se dalje nastavila, dok su s vremena na vrijeme praktički sve kopnene površine bile

the land of the world is connected by slender isthmuses and narrow land bridges.

As the land emerges from the last Silurian inundation, an important period in world development and life evolution comes to an end. It is the dawn of a new age on earth. The naked and unattractive landscape of former times is becoming clothed with luxuriant verdure, and the first magnificent forests will soon appear.

The marine life of this age was very diverse due to the early species segregation, but later on there was free commingling and association of all these different types. The brachiopods early reached their climax, being succeeded by the arthropods, and barnacles made their first appearance. But the greatest event of all was the sudden appearance of the fish family. This became the age of fishes, that period of the world's history characterized by the *vertebrate* type of animal.

270,000,000 years ago the continents were all above water. In millions upon millions of years not so much land had been above water at one time; it was one of the greatest land-emergence epochs in all world history.

Five million years later the land areas of North and South America, Europe, Africa, northern Asia, and Australia were briefly inundated, in North America the submergence at one time or another being almost complete; and the resulting limestone

uzajamno povezane vitkim tjesnacima i uskim kopnenim mostovima.

Kako se kopno uzdiglo iz posljednjeg Silurskog potopa, okončalo se jedno važno razdoblje u svjetskom razvoju i evoluciji života. Došlo je do svitanja novog doba na Zemlji. Goli i neprivlačni krajolik iz raznijih razdoblja s vremenom je odjeven bujnim zelenilom, a uskoro se javljaju i prve veličanstvene šume.

Morski život ove dobi bio je vrlo raznolik zahvaljujući odvajanju ranih oblika života, dok je kasnije došlo do nesmetanog miješanja i udruživanja svih tih različitih vrsta. Brahiopodi rano dostižu vrhunac, a za njima slijede člankonošci, nakon kojih se prvi put javljaju školjke. No, najbitniji događaj je iznenadna pojava obitelji riba. Ovo je period vladavine riba, razdoblje svjetske povijesti koje je obilježeno *kralješnjacima*.

Prije 270 milijuna godina kontinenti su i dalje bili iznad površine vode. Kroz više milijuna godina svijet nije vidio tako veliku kopnenu masu; bila je to jedna od najvećih epoha kopnenog porasta u cijeloj svjetskoj povijesti.

Pet milijuna godina nakon ovih događaja dolazi do kratkog potapanja kopnenih područja Sjeverne i Južne Amerike, Europe, Afrike, sjeverne Azije i Australije, a u Sjevernoj Americi potapanje je u jednom ili drugom razdoblju bilo gotovo

layers run from 500 to 5,000 feet in thickness. These various Devonian seas extended first in one direction and then in another so that the immense arctic North American inland sea found an outlet to the Pacific Ocean through northern California.

260,000,000 years ago, toward the end of this land-depression epoch, North America was partially overspread by seas having simultaneous connection with the Pacific, Atlantic, Arctic, and Gulf waters. The deposits of these later stages of the first Devonian flood average about one thousand feet in thickness. The coral reefs characterizing these times indicate that the inland seas were clear and shallow. Such coral deposits are exposed in the banks of the Ohio River near Louisville, Kentucky, and are about one hundred feet thick, embracing more than two hundred varieties. These coral formations extend through Canada and northern Europe to the arctic regions.

Following these submergences, many of the shore lines were considerably elevated so that the earlier deposits were covered by mud or shale. There is also a red sandstone stratum which characterizes one of the Devonian sedimentations, and this red layer extends over much of the earth's surface, being found in North and South America, Europe, Russia, China, Africa, and Australia. Such red deposits are suggestive of arid or semiarid conditions, but the climate of this epoch was still mild and even.

potpuno; slojevi vapnenca koji su tada formirani imali su razmjere od 150 do 1,500 metara. Ta su se različita Devonska mora pružala u različitim smjerovima, tako da se ogromno unutarnje more arktičke Sjeverne Amerike izlilo u Tihi ocean preko sjeverne Kalifornije.

Prije 260 milijuna godina, pred kraj epohe obilježene kopnenom depresijom, Sjeverna Amerika je djelomično bila prekrivena razgranatim morima koja su istovremeno bila povezana s Tihim oceanom, Atlantskim oceanom, Arktičkim morem i Meksičkim zaljevom. Depoziti iz tih kasnijih faza prvog Devonskog potopa u prosjeku imaju razmjer od otprilike tri stotine metara. Koraljni grebeni iz ovih doba ukazuju na to da su u unutrašnjosti mora bila prozirna i plitka. Takvi se koraljni depoziti mogu naći na obalama rijeke Ohajo u blizini Louisvila u državi Kentaki, u rasponu od nekih trideset metara, u više od dvije stotine varijanti. Ove se koraljne formacije protežu kroz Kanadu i sjevernu Europu do arktičkih područja.

Nakon tih potopa, bitno su uvećane mnoge obalne linije, tako da su raniji depoziti prekriveni blatom ili škriljevcem. Tu je i crveni sloj pješčenjaka, obilježje jedne devonske sedimentacije, a taj se crveni sloj proteže preko velikog dijela Zemljine površine i može se naći u Sjevernoj i Južnoj Americi, Europi, Rusiji, Kini, Africi i Australiji. Takvi crveni depoziti upućuju na suhe ili polusuhe uvjete, dok su ove epohe još uvijek bile obilježene blagom i ujednačenom klimom.

Throughout all of this period the land southeast of the Cincinnati Island remained well above water. But very much of western Europe, including the British Isles, was submerged. In Wales, Germany, and other places in Europe the Devonian rocks are 20,000 feet thick.

250,000,000 years ago witnessed the appearance of the fish family, the vertebrates, one of the most important steps in all prehuman evolution.

The arthropods, or crustaceans, were the ancestors of the first vertebrates. The forerunners of the fish family were two modified arthropod ancestors; one had a long body connecting a head and tail, while the other was a backboneless, jawless prefish. But these preliminary types were quickly destroyed when the fishes, the first vertebrates of the animal world, made their *sudden* appearance from the north.

Many of the largest true fish belong to this age, some of the teeth-bearing varieties being twenty-five to thirty feet long; the present-day sharks are the survivors of these ancient fishes. The lung and armored fishes reached their evolutionary apex, and before this epoch had ended, fishes had adapted to both fresh and salt waters.

Veritable bone beds of fish teeth and skeletons may be found in the deposits laid down toward the close of this period, and rich fossil beds

Kroz cijelo ovo razdoblje, zemljište koje leži jugoistočno od Cincinnati otoka ostalo je iznad površine vode. No, velik dio zapadne Europe, uključujući i Britansko otočje, nalazio se pod vodom. Velš, Njemačka i druga mjesta u Europi imaju devonske stijene u razmjeru od nekih 6,000 metara.

Razdoblje od prije 250 milijuna godina svjedoči pojavom riblje obitelji, kralježnjaka, što je jedan od najbitnijih koraka u procesu predljudske evolucije.

Člankonožci, ili rakovi, bili su preci prvih kralježnjaka. Preteče riblje obitelji bila su dva modificirana pretka člankonožaca; jedan je imao dugo tijelo koje je povezivalo glavu s repom, dok je drugi bio bezkralježnjak, rani predak ribe koji nije imao čeljusti. No, ove su preliminarne vrste vrlo brzo uništene kad su se na sjeveru *iznanada* pojavile ribe, prvi kralježnjaci životinjskog svijeta.

Mnogi od najvećih istinskih riba pripadaju toj dobi, a neke zubate varijante dosežu duljinu od osam do deset metara; današnji morski psi su preci tih drevnih riba. Plućne i oklopne ribe dosežu evolucijski vrhunac i prije svršetka ove epohe, ribe se prilagođavaju i slatkoj i slanoj vodi.

Cijela morska korita ispunjena ribljim zubima i kosturima mogu se naći u depozitima formiranim pred kraj tog razdoblja, a bogati fosilni depoziti su

are situated along the coast of California since many sheltered bays of the Pacific Ocean extended into the land of that region.

The earth was being rapidly overrun by the new orders of land vegetation. Heretofore few plants grew on land except about the water's edge. Now, and *suddenly*, the prolific *fern family* appeared and quickly spread over the face of the rapidly rising land in all parts of the world. Tree types, two feet thick and forty feet high, soon developed; later on, leaves evolved, but these early varieties had only rudimentary foliage. There were many smaller plants, but their fossils are not found since they were usually destroyed by the still earlier appearing bacteria.

As the land rose, North America became connected with Europe by land bridges extending to Greenland. And today Greenland holds the remains of these early land plants beneath its mantle of ice.

240,000,000 years ago the land over parts of both Europe and North and South America began to sink. This subsidence marked the appearance of the last and least extensive of the Devonian floods. The arctic seas again moved southward over much of North America, the Atlantic inundated a large part of Europe and western Asia, while the southern Pacific covered most of India. This inundation was slow in appearing and equally slow in retreating. The Catskill Mountains along the west bank of the Hudson River are one of the largest geologic monuments of this epoch to be found on the surface of North

smješteni uz obalu Kalifornije, kako su se mnoge zaklonjene uvale Tihog oceana protezale preko kopnenih površina tog područja.

Zemlja je uskoro vrvila novim vrstama kopnene vegetacije. Do tada je tek mali broj biljaka rastao na kopnu osim duž obale. Sada, i *iznenada*, javlja se plodna obitelj paprati koja se brzo širi na sve većoj površini zemlje u svim dijelovima svijeta. Uskoro se javljaju vrste drveta u razmjeru od šezdeset centimetara i visini od dvanaest metara; zatim dolazi do pojave lišća, dok ovi rani oblici imaju jedino rudimentarni oblik lišća. Bilo je i mnogo manjih biljaka, ali njihovi fosili se ne mogu naći zahvaljujući djelovanju već postojećih bakterija.

S podizanjem kopna, Sjeverna Amerika se povezuje s Europom kopnenim mostovima koji se protežu do Grenlanda. Na Grenlandu i danas postoje ostaci tih ranih kopnenih biljaka ispod ledenog pokrivača.

Prije 240 milijuna godina kopno u dijelovima Europe i Sjeverne i Južne Amerike počinje tonuti. Ovo ulegnuće obilježava posljednji i najmanje opsežan Devonski potop. Arktičko se more još jednom pomjera prema jugu preko većeg dijela Sjeverne Amerike, dok Atlantski ocean prekriva veći dio Europe i zapadne Azije, a južni kraj Tihog oceana pokriva veći dio Indije. Ovaj je potop bio spor u pojavi i jednako spor u procesu povlačenja. Katskil planine koje se podižu duž zapadne obale rijeke Hudson predstavljaju jedan od najvećih geoloških spomenika tog doba na površini od Sjeverne

America.

230,000,000 years ago the seas were continuing their retreat. Much of North America was above water, and great volcanic activity occurred in the St. Lawrence region. Mount Royal, at Montreal, is the eroded neck of one of these volcanoes. The deposits of this entire epoch are well shown in the Appalachian Mountains of North America where the Susquehanna River has cut a valley exposing these successive layers, which attained a thickness of over 13,000 feet.

The elevation of the continents proceeded, and the atmosphere was becoming enriched with oxygen. The earth was overspread by vast forests of ferns one hundred feet high and by the peculiar trees of those days, silent forests; not a sound was heard, not even the rustle of a leaf, for such trees had no leaves.

And thus drew to a close one of the longest periods of marine-life evolution, *the age of fishes*. This period of the world's history lasted almost fifty million years; it has become known to your researchers as the *Devonian*.

5. THE CRUSTAL-SHIFTING STAGE – THE FERM-FOREST CARBONIFEROUS PERIOD – THE AGE OF FROGS

The appearance of fish during the preceding period marks the apex of marine-life evolution.

Amerike.

Prije 230 milijuna godina mora se nastavljaju povlačiti. Velik dio Sjeverne Amerike bio je iznad vode, sa snažnim vulkanskim djelovanjem u području St. Laurencea. Planina Royal u Montrealu, jedan je od umanjenih vratova jednog od tih vulkana. Depoziti cijele ove epohe mogu se vidjeti u Apalačanskim planinama Sjeverne Amerike, gdje rijeka Susquehana probija dolinu izlažući na vidjelo ove uzastopne slojeve, koji postižu razmer od preko 4,000 metara.

Kontinenti su nastavili rasti u nadmorskoj visini, a atmosfera je imala sve više kisika. Zemlja je bila prekrivena ogromnim šumama paprati visokim po trideset metara i neobičnim stablima iz ondašnjih tihih šuma; u njima se nije čuo ni zvuk, čak ni šuškanje lišća, jer stabala nisu imala lišće.

I tako se završava jedan od najdužih perioda evolucije morskog života, *doba riba*. To razdoblje svjetske povijesti trajao je gotovo 50 milijuna godina; postalo je poznato među vašim istraživačima kao *devon*.

5. RAZDOBLJE POMJERANJA ZEMLJINE KORE – DOBA KARBONIFERNIH PAPERATI – RAZDOBLJE ŽABA

Pojava riba tijekom prethodnog razdoblja označava vrhunac evolucije morskog života. Od tog

From this point onward the evolution of land life becomes increasingly important. And this period opens with the stage almost ideally set for the appearance of the first land animals.

220,000,000 years ago many of the continental land areas, including most of North America, were above water. The land was overrun by luxurious vegetation; this was indeed the *age of ferns*. Carbon dioxide was still present in the atmosphere but in lessening degree.

Shortly thereafter the central portion of North America was inundated, creating two great inland seas. Both the Atlantic and Pacific coastal highlands were situated just beyond the present shore lines. These two seas presently united, commingling their different forms of life, and the union of these marine fauna marked the beginning of the rapid and world-wide decline in marine life and the opening of the subsequent land-life period.

210,000,000 years ago the warm-water arctic seas covered most of North America and Europe. The south polar waters inundated South America and Australia, while both Africa and Asia were highly elevated.

When the seas were at their height, a new evolutionary development *suddenly* occurred. Abruptly, the first of the land animals appeared. There were numerous species of these animals that were able to live on land or in water. These air

trenutka evolucija kopnenog život postaje sve važnija. I ovo se razdoblje javlja na pozornici upravo u vrijeme koje je bilo gotovo idealno za pojavu prvih kopnenih životinja.

Prije 220 milijuna godina mnoga kontinentalna kopnena područja, uključujući i veći dio Sjeverne Amerike, bila su iznad vode. Kopno vrvi raskošnom vegetacijom; a to je doista bila *dob paprati*. Ugljični dioksid je još uvijek prisutan u atmosferi, ali u sve manjem stupnju.

Ubrzo nakon toga ponovo je preplavljen središnji dio Sjeverne Amerike i došlo je do stvaranja dva velika unutrašnja mora. Obale Atlantskog i Tihog oceana bile su u neposrednoj blizini današnjih. Ova dva mora su tako ujedinjena, tako da je došlo do miješanja njihovih različitih oblika života, a miješanje ovih dvaju oblika morske faune označava početak brzog i općesvjetskog pada morskog života i otvaranje kopnenog razdoblja.

Prije 210 milijuna godina topla voda Arktičkog mora pokriva većinu Sjeverne Amerike i Europe. Na jugu polarne vode preplavljaju Južnu Ameriku i Australiju, dok su i Afrika i Azija visoko uzdignute.

Kad su mora bila na vrhuncu, *iznenada* dolazi do novog evolucijskog razvoja. Preko noći, javljaju se prve kopnene životinje. Bile su i brojne vrste životinja koje su imale mogućnosti da žive na kopnu i u vodi. Ovi su vodozemci

breathing amphibians developed from the arthropods, whose swim bladders had evolved into lungs.

From the briny waters of the seas there crawled out upon the land snails, scorpions, and frogs. Today frogs still lay their eggs in water, and their young first exist as little fishes, tadpoles. This period could well be known as the *age of frogs*.

Very soon thereafter the insects first appeared and, together with spiders, scorpions, cockroaches, crickets, and locusts, soon overspread the continents of the world. Dragon flies measured thirty inches across. One thousand species of cockroaches developed, and some grew to be four inches long.

Two groups of echinoderms became especially well developed, and they are in reality the guide fossils of this epoch. The large shell-feeding sharks were also highly evolved, and for more than five million years they dominated the oceans. The climate was still mild and equable; the marine life was little changed. Fresh-water fish were developing and the trilobites were nearing extinction. Corals were scarce, and much of the limestone was being made by the crinoids. The finer building limestones were laid down during this epoch.

The waters of many of the inland seas were so heavily charged with lime and other minerals as

imali moć disanja zraka i razvili su se od člankonožaca, čiji su se mjehuri za plivanje razvili u pluća.

Iz slanih morskih voda na zemlju su ispuzali puževi, škorpioni i žabe. Žabe i dalje polažu jaja u vodi, a njihovi mladi započinju život kao ribice, punoglavci. To razdoblje bi moglo biti poznato kao *dob žaba*.

Nedugo zatim javljaju se prvi kukci koji se zajedno s paucima, škorpionima, žoharima, cvrčcima i skakavcima, uskoro šire po svim kontinentima svijeta. Vilin konjic ima krila u promjeru od sedamdeset pet centimetara. Javlja se tisuću vrsta žohara, a neki su bili dugi deset centimetara.

Dvije skupine bodljikaša postaju osobito dobro razvijene, a oni su u stvarnosti vodeći fosili ove epohe. Veliki morski psi koji se hrane školjkama također su visoko evoluirali i kroz više od pet milijuna godina dominirali oceanima. Klima je još uvijek bila blaga i ujednačena; morski život se malo promijenio. Slatkovodne ribe se razvijaju i trilobiti se bliže točki izumiranja. Koralji su bili rijetki, a vapnenac je uglavnom bio djelo krinoida. Finiji vapnenci koji se koriste u gradnji formirani su tijekom ove epohe.

Vode mnogih unutarnjih mora tako su prepune vapna i drugih minerala koji jako utiču

greatly to interfere with the progress and development of many marine species. Eventually the seas cleared up as the result of an extensive stone deposit, in some places containing zinc and lead.

The deposits of this early Carboniferous age are from 500 to 2,000 feet thick, consisting of sandstone, shale, and limestone. The oldest strata yield the fossils of both land and marine animals and plants, along with much gravel and basin sediments. Little workable coal is found in these older strata. These depositions throughout Europe are very similar to those laid down over North America.

Toward the close of this epoch the land of North America began to rise. There was a short interruption, and the sea returned to cover about half of its previous beds. This was a short inundation, and most of the land was soon well above water. South America was still connected with Europe by way of Africa.

This epoch witnessed the beginning of the Vosges, Black Forest, and Ural mountains. Stumps of other and older mountains are to be found all over Great Britain and Europe.

200,000,000 years ago the really active stages of the Carboniferous period began. For twenty million years prior to this time the earlier coal deposits were being laid down, but now the

na napredak i razvoj mnogih morskih vrsta. Na kraju se mora čiste kao rezultat opsežnog taloženja kamena, u nekim mjestima sadrže cink i olovo.

Depoziti ovog ranog doba karbona formirani su u rasponu od 150 do 600 metara, a u sebi nose pješčenjak, škriljac i vapnenac. Najstariji slojevi nose fosile kopnenih kao i morskih životinja i biljaka, zajedno s mnogo šljunka i slivova sedimenata. Malo djelatnog ugljena ulazi u ove starije slojeve. Depoziti koji se mogu naći diljem Europe vrlo su slični depozitima diljem Sjeverne Amerike.

Pred kraj ove epohe dolazi do uzdizanja kopna Sjeverne Amerike. Nakon kratkog prekida, more ponovo pokriva polovicu svog prijašnjeg korita. No bilo je to kratkotrajno plavljenje i veći dio kopna se uskoro ponovo izdigao iz vode. Južna Amerika je još uvijek bila povezana s Europom preko Afrike.

Ova epoha svjedoči početkom stvaranja Vosgesa, Svarzvalda i Urala. Podnožja drugih i starijih planina mogu se naći diljem Velike Britanije i Europe.

Prije 200 milijuna godina počinje razdoblje vrlo aktivne faze karbona. Tijekom 20 milijuna godina prethodno tom razdoblju formirane su ranije rezerve ugljena, no sada dolazi do opsežnijih

more extensive coal-formation activities were in process. The length of the actual coal-deposition epoch was a little over twenty-five million years.

The land was periodically going up and down due to the shifting sea level occasioned by activities on the ocean bottoms. This crustal uneasiness — the settling and rising of the land — in connection with the prolific vegetation of the coastal swamps, contributed to the production of extensive coal deposits, which have caused this period to be known as the *Carboniferous*. And the climate was still mild the world over.

The coal layers alternate with shale, stone, and conglomerate. These coal beds over central and eastern United States vary in thickness from forty to fifty feet. But many of these deposits were washed away during subsequent land elevations. In some parts of North America and Europe the coal-bearing strata are 18,000 feet in thickness.

The presence of roots of trees as they grew in the clay underlying the present coal beds demonstrates that coal was formed exactly where it is now found. Coal is the water-preserved and pressure-modified remains of the rank vegetation growing in the bogs and on the swamp shores of this faraway age. Coal layers often hold both gas and oil. Peat beds, the remains of past vegetable growth, would be converted into a type of coal if subjected to proper pressure and heat. Anthracite has been subjected to more pressure and heat than other coal.

aktivnosti koje vode formiranju ugljena. Duljina stvarnog procesa taloženja ugljena traje nešto više od 25 milijuna godina.

Kopno se još uvijek povremeno uzdizalo i spuštalo zahvaljujući aktivnostima na dnu oceana. Ova nestabilnost zemljine kore – naizmjenično spuštanje i podizanje kopna – povezano s plodnom vegetacijom obalnih močvara, vodi proizvodnji velikih depozita ugljena, tako da je ovaj period poznat kao *razdoblje karbona*. Klima je još uvijek bila blaga na cijelom svijetu.

Slojevi ugljena smjenjuju se sa slojevima škriljca, kamena i konglomerata. Ovi se depoziti ugljena preko središnjeg i istočnog područja Sjedinjenih Država kreću u razmjeru od dvanaest do petnaest metara. No, mnogi od tih depozita su oprani prilikom budućih uzdizanja kopna. U nekim dijelovima Sjeverne Amerike i Europe depoziti ugljena imaju razmjer od 5,400 metara.

Prisutnost korijenja koje je nekoć pripadalo stablima koja su rasla u glini u sastavu ovog ležišta ugljena ukazuje na to da je ugljen nastao upravo tamo gdje se danas može naći. Ugljen predstavlja ostatke vodene vegetacije modificirane pod pritiskom, koja je nekoć rasla na tresetištima i na močvarnim obalama tog dalekog doba. Slojevi ugljena često sadrže i gas i ulje. Depoziti treseta, ostaci negdašnje vegetacije, pretvaraju se u neku vrstu antracita ili čvrstog ugljena ako se nađu podvrgnuti određenom pritisku i toplini.

In North America the layers of coal in the various beds, which indicate the number of times the land fell and rose, vary from ten in Illinois, twenty in Pennsylvania, thirty-five in Alabama, to seventy-five in Canada. Both fresh- and salt-water fossils are found in the coal beds.

Throughout this epoch the mountains of North and South America were active, both the Andes and the southern ancestral Rocky Mountains rising. The great Atlantic and Pacific high coastal regions began to sink, eventually becoming so eroded and submerged that the coast lines of both oceans withdrew to approximately their present positions. The deposits of this inundation average about one thousand feet in thickness.

190,000,000 years ago witnessed a westward extension of the North American Carboniferous sea over the present Rocky Mountain region, with an outlet to the Pacific Ocean through northern California. Coal continued to be laid down throughout the Americas and Europe, layer upon layer, as the coastlands rose and fell during these ages of seashore oscillations.

180,000,000 years ago brought the close of the Carboniferous period, during which coal had been formed all over the world — in Europe, India, China, North Africa, and the Americas. At the close of the coal-formation period North America east of the Mississippi valley rose, and most of this section has ever since remained above the sea. This land-

U Sjevernoj Americi slojevi ugljena leže u različitim depozitima, što ukazuje na broj uniženja i podizanja kopna i varira od deset u Illinoisu, dvadeset u Pensilvaniji, trideset pet u Alabami, do sedamdeset pet u Kanadi. Ostaci životinja iz slane kao i slatke vode nalaze se u tim ležištima uglja.

Tijekom ove epohe aktivne su planine Sjeverne i Južne Amerike i dolazi do podizanja Andi i južnih predaka Roki planina. Velika obalna područja Atlantskog i Tihog oceana počinju tonuti i na kraju postaju toliko oštećena erozijom i potopljena da se obalna linija oba oceana povlači otprilike do njihove sadašnje pozicije. Depoziti stvoreni ovom poplavom imaju prosječnu debljinu od otprilike tri stotine metara.

Prije 190 milijuna godina dolazi do zapadnog izduženja sjeverno-američkog karbonifernog mora na području današnjih Roki planina i do njegovog izlivanja u Tihog oceana preko sjeverne Kalifornije. Ugljen se i dalje nastavio formirati diljem Amerike i Europe, sloj za slojem, kako su se obalna područja podizala i spuštala tijekom ove dobi oscilacije morskih obala.

Prije 180 milijuna godina dolazi do kraja karbonskog razdoblja tijekom kojeg su formirani depoziti ugljena diljem svijeta - u Europi, Indiji, Kini, sjevernoj Africi i Americi. Na kraju ovog razdoblja obilježenog formacijom ugljena, uzdignuta je obala Sjeverne Amerike istočno od doline Misisipija, a većina tog područja ostaje

elevation period marks the beginning of the modern mountains of North America, both in the Appalachian regions and in the west. Volcanoes were active in Alaska and California and in the mountain-forming regions of Europe and Asia. Eastern America and western Europe were connected by the continent of Greenland.

Land elevation began to modify the marine climate of the preceding ages and to substitute therefor the beginnings of the less mild and more variable continental climate.

The plants of these times were spore bearing, and the wind was able to spread them far and wide. The trunks of the Carboniferous trees were commonly seven feet in diameter and often one hundred and twenty-five feet high. The modern ferns are truly relics of these bygone ages.

In general, these were the epochs of development for fresh-water organisms; little change occurred in the previous marine life. But the important characteristic of this period was the *sudden* appearance of the frogs and their many cousins. The life features of the coal age were *ferns* and *frogs*.

iznad mora. Ovo razdoblje kopnenog uzdizanja obilježava početak formiranja modernih planina Sjeverne Amerike, kako na području Apalača tako i prema zapadu. Vulkani su bili aktivni na Aljasci i u Kaliforniji i područjima Europe i Azije gdje je došlo do formiranja planina. Istočna Amerika i zapadna Europa bile su povezane preko Grenlanda.

Nadmorska visina kopna počela je mijenjati negdašnju morsku klimu na čije su mjesto stupili počeci manje ujednačene i varijabilnije kontinentalne klime.

Vegetacija iz ovog razdoblja obilježena je sporama koje je vjetar nadaleko i naširoko raznosio. Stabla karbonifernog drveća najčešće su imala promjer od dva metra i često su rasla u visinu do otprilike četrdeset metara. Moderne paprati doista predstavljaju ostatke te daleke prošlosti.

Bila je to u principu epoha razvoja slatkovodnih organizama; ranije formirane morske životinje ostaju uglavnom nepromijenjene. No, važna karakteristika tog razdoblja je *iznenadna* pojava žaba i njihovih brojnih rođaka. Značajke života koji se javio u doba ugljena su *paprati* i *žabe*.

6. THE CLIMATIC TRANSITION STAGE THE SEED-PLANT PERIOD THE AGE OF BIOLOGIC TRIBULATION

This period marks the end of pivotal evolutionary development in marine life and the opening of the transition period leading to the subsequent ages of land animals.

This age was one of great life impoverishment. Thousands of marine species perished, and life was hardly yet established on land. This was a time of biologic tribulation, the age when life nearly vanished from the face of the earth and from the depths of the oceans. Toward the close of the long marine-life era there were more than one hundred thousand species of living things on earth. At the close of this period of transition less than five hundred had survived.

The peculiarities of this new period were not due so much to the cooling of the earth's crust or to the long absence of volcanic action as to an unusual combination of commonplace and pre-existing influences — restrictions of the seas and increasing elevation of enormous land masses. The mild marine climate of former times was disappearing, and the harsher continental type of weather was fast developing.

6. DOBA KLIMATSKIH PROMJENA - RAZDOBLJE SJEMENKI – EPOHA BILOŠKOG STRADANJA

Ovo razdoblje obilježava kraj ključnog evolucijskog razvoja morskog života i početak prijelaznog razdoblja koje vodi prema kasnijim dobima kopnenih životinja.

Ova je dob obilježena jednim velikim osiromašenjem života. Ovom prilikom propadaju stotine tisuća oblika morskog života, a život se tek neznatno uspostavio na kopnu. Bilo je to vrijeme biološkog stradanja, kad je život gotovo nestao s lica zemlje i iz dubine oceana. Na koncu dugog razdoblja kojim su dominirali morski oblici života, na zemlji je postojalo više od stotinu tisuća vrsta živih bića. Pred kraj ovog razdoblja tranzicije opstalo je manje od pet stotina.

Specifičnosti ovog novog razdoblja nisu toliko bile rezultat hlađenja zemljine kore ili dugog razdoblja bez vulkanskog djelovanja, koliko su bile rezultat neobične kombinacije banalnih i odveć postojećih utjecaja – ograničene površine mora i povećanja elevacije ogromnih kopnenih masa. U ovo vrijeme nestaje blaga morska klima koja je obilježavala prijašnja razdoblja, a na njezino mjesto stupa oštrija kontinentalna klima.

170,000,000 years ago great evolutionary changes and adjustments were taking place over the entire face of the earth. Land was rising all over the world as the ocean beds were sinking. Isolated mountain ridges appeared. The eastern part of North America was high above the sea; the west was slowly rising. The continents were covered by great and small salt lakes and numerous inland seas which were connected with the oceans by narrow straits. The strata of this transition period vary in thickness from 1,000 to 7,000 feet.

The earth's crust folded extensively during these land elevations. This was a time of continental emergence except for the disappearance of certain land bridges, including the continents which had so long connected South America with Africa and North America with Europe.

Gradually the inland lakes and seas were drying up all over the world. Isolated mountain and regional glaciers began to appear, especially over the Southern Hemisphere, and in many regions the glacial deposit of these local ice formations may be found even among some of the upper and later coal deposits. Two new climatic factors appeared — glaciation and aridity. Many of the earth's higher regions had become arid and barren.

Throughout these times of climatic change, great variations also occurred in the land plants. The *seed plants* first appeared, and they afforded a better food supply for the subsequently increased land

Prije 170 milijuna godina širom svijeta dolazi do velikih evolucijskih prilagodbi i promjena. Kopno se uzdizalo po cijelom svijetu kako su tonula dna oceanskog korita. Došlo je do pojave izoliranih planinskih grebena. Istočni dio Sjeverne Amerike uzdigao se visoko iznad površine mora; zapadni se polagano uzdizao. Kontinenti bili prekriveni velikim i malim slanim jezerima s brojnim unutarnjim morima koja su uskim prolazima bila povezana sa oceanima. Slojevi ovog prijelaznog razdoblja razlikuju se u debljini od 300 do 2,000 metara.

Zemljina je kora intenzivno izpresavijana u procesu kopnenog uzdizanja. Bilo je to razdoblje kontinentalne izgradnje, izuzev nestanka određenih zemljišnih mostova koji uključuju kontinentalne spone koje su tako dugo povezivale Južnu Ameriku s Afrikom i Sjevernu Ameriku s Europom.

Postupno dolazi do sušenja unutarnjih jezera i mora. Počinju se javljati izolirani planinski i regionalni ledenjaci, osobito u južnoj hemisferi, a u mnogim regijama koje su prekrivene glacijalnim depozitima ove se lokalne formacije leda mogu naći čak i među nekim od gornjih i kasnijih depozita ugljena. Dolazi do pojave dva nova klimatska faktora - glacijacije i suhe klime. Mnogi visinski predjeli postaju suhi i neplodni.

Tijekom ovog razdoblja klimatskih promjena, dolazi do velike varijacije kopnene vegetacije. Prvi put se javljaju *biljke sa sjemenkama*, koje su bolje opskrbljene hranom pri predstojećem uvećanju broja

animal life. The insects underwent a radical change. The *resting stages* evolved to meet the demands of suspended animation during winter and drought.

Among the land animals the frogs reached their climax in the preceding age and rapidly declined, but they survived because they could long live even in the drying-up pools and ponds of these far-distant and extremely trying times. During this declining frog age, in Africa, the first step in the evolution of the frog into the reptile occurred. And since the land masses were still connected, this prereptilian creature, an air breather, spread over all the world. By this time the atmosphere had been so changed that it served admirably to support animal respiration. It was soon after the arrival of these prereptilian frogs that North America was temporarily isolated, cut off from Europe, Asia, and South America.

The gradual cooling of the ocean waters contributed much to the destruction of oceanic life. The marine animals of those ages took temporary refuge in three favorable retreats: the present Gulf of Mexico region, the Ganges Bay of India, and the Sicilian Bay of the Mediterranean basin. And it was from these three regions that the new marine species, born to adversity, later went forth to replenish the seas.

160,000,000 years ago the land was largely covered with vegetation adapted to support land-animal life, and the atmosphere had become ideal

kopnenih životinja. Insekti podilaze korijenitu promjenu. Dolazi do razvoja *latentnih faza* kako bi se zadovoljili zahtjevi za umanjenom aktivnosti u vrijeme zime i suše.

Među kopnenim životinjama žabe su već dostigle vrhunac razvoja i ovom prilikom naglo nazaduju, ali se uspijevaju održati zahvaljujući sposobnosti opstanka u suhim bazenima i ribnjacima ovih davnih i iznimno teških vremena. Tijekom ovog razdoblja koje je obilježeno nazadovanjem žaba, u Africi dolazi do prvog koraka u njihovoj evoluciji u smjeru gmizavaca. A budući da su kopnene mase ipak bile povezane, ovaj se rani stadij u razvoju gmizavaca, koji su disao na pluća, proširio po cijelom svijetu. U ovo vrijeme atmosfera se toliko izmijenila da je pružala dobru podršku plućnom disanju. Nedugo nakon pojave tih žaba od kojih nastaju rani gmizavci, privremeno je izolirana Sjeverna Amerika od Europe, Azije i Južne Amerike.

Postupno hlađenje oceanskih voda uveliko doprinosi uništenju oceanskog života. Morske životinje ove dobi nalaze privremeno utočište u tri blaga podneblja: današnjem području Meksičkog zaljeva, Ganges zaljeva Indije i sicilijanskog zaljeva u Sredozemlju. U ove tri regije razvijaju se nove vrste morskih životinja, rođene u teškim uvjetima, koje se kasnije umnožavaju i pune mora.

Prije 160 milijuna godina zemlja je u velikoj mjeri bila prekrivena vegetacijom koja je bila prilagođena pružanju podrške razvoju životinjskog

for animal respiration. Thus ends the period of marine-life curtailment and those testing times of biologic adversity which eliminated all forms of life except such as had survival value, and which were therefore entitled to function as the ancestors of the more rapidly developing and highly differentiated life of the ensuing ages of planetary evolution.

The ending of this period of biologic tribulation, known to your students as the *Permian*, also marks the end of the long *Paleozoic* era, which covers one quarter of the planetary history, two hundred and fifty million years.

The vast oceanic nursery of life on Urantia has served its purpose. During the long ages when the land was unsuited to support life, before the atmosphere contained sufficient oxygen to sustain the higher land animals, the sea mothered and nurtured the early life of the realm. Now the biologic importance of the sea progressively diminishes as the second stage of evolution begins to unfold on the land.

[Presented by a Life Carrier of Nebadon, one of the original corps assigned to Urantia.]

svijeta na kopnu, dok je atmosfera postala idealna za plućno disanje. Tako završava razdoblje obilježeno propadanjem velikog broja morskih životinja i teškim iskušenjima bioloških nedaća koja su eliminirale sve oblike života osim onih koji su imali sposobnost opstanka, a koji su zbog toga imali pravo funkcionirati kao preci novih oblika života koji su brzo evoluirali i postali bitno diferencirani u predstojećim dobima planetarne evolucije.

Tako dolazi do svršetka tog razdoblja bioloških nevolja koje je vama poznato kao *permian*, a koje također obilježava kraj dugog razdoblja *paleocena* koji pokriva četvrtinu planetarne povijesti ili 250 milijuna godina.

Veliki oceanski podij za razvoj života na Urantiji poslužio je svojoj svrsi. Tijekom dugih dobi kad je zemlja bila neprikladna za održanje života, prije nego što je atmosfera sadržavala dovoljno kisika za održanje viših kopnenih životinja, more je igralo ulogu majke koja je rodila život i pružila mu najraniju njegu. Ovom prilikom postupno se smanjuje biološki značaj mora dok se druga faza evolucije života odvija na kopnu.

[Predočio Nositelj Života iz Nebadona, pripadnik izvornog korpusa koji je dodijeljen Urantiji.]