FIELD EVIDENCE OF RAPID SEDIMENTATION

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Recent research reports and original photographs are presented to substantiate catastrophic and rapid Mesozoic and Paleozoic sedimentation. Bentonite clay is directly related to volcanic eruptions. Violent crustal tectonics are related to all Paleozoic deposits. The vast difference between Paleozoic and Mesozoic sediments neatly correlates Paleozoic sediments to the duration of the higher water levels of the Noachian Flood. Geological strata reinforce faith in the veracity of the Bible.

Introduction

Authors of recent reports in geology are emphasizing restudy and reinterpretation of the mechanism and rates of sedimentary processes. Evolutionists are recognizing the failures and fallacies of classical uniformitarianism. They are admitting the necessity of blending catastrophism with neo-uniformitarianism. Recent field observations I made on camping trips together with photographs taken in the laboratory are presented to encourage more re-evaluation of geological interpretations by geologists and students.

Bentonite and Volcanism

Many visitors of the Western States have been awed by the rounded "teepees" of the Painted Desert in Arizona, and similar formations in Wyoming, and in Alberta, Canada. They marvel at the range of colors from purples, reds and yellows to greens and blues of the Mesozoic shales.

The Carlisle and Benton Shales of the Colorado Group (lower middle Cretaceous) are important sources of bentonite in northeastern Wyoming. My wife and I visited the Industrial Mineral and Chemical Corporation processing plant in June 1972, located about 20 miles west northwest of Belle Fourche, South Dakota.

These Cretaceous strata are weakly lithified. Evidence of the spongy consistency is the warped, rolling railway spur leading to the plant. A locomotive was derailed about a half mile east of the processing plant. Such derailment was a frequent occurrence according to Martin Krone, the laboratory analyst. He added that this plant has been processing gray, brown, yellow, green and blue bentonite.

Bentonite is of interest to creationists because of its origin. It is used as a Fuller's earth to plug up seepage into wells. It is rich in montmorillonite, $(Al\ Mg)_8(Si_4O_{10})_3OH_{10}12H_2O$, an expanding 2:1 layered smectite clay mineral. Deer, Howie and Zussman[1] state, "These have been formed by the alteration of eruptive igneous rocks, usually tuffs and volcanic ash . . . sodium is the naturally occurring exchange cation"; and they add:

> . . . thus montmorillonite results from the weathering of basic rocks mainly in conditions of poor drainage when magnesium is not removed . . . (and is favored by) . . . an alkaline environment, availability of calcium, and paucity of potassium.[2]

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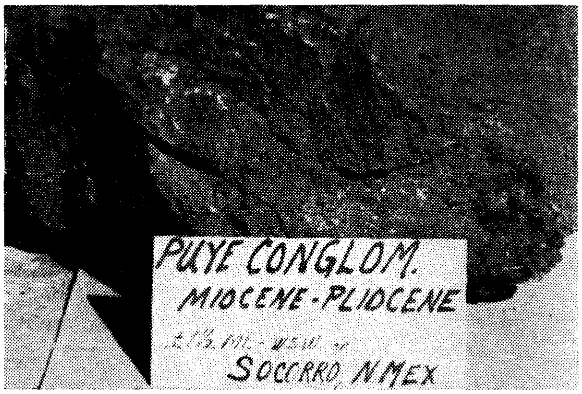

Figure 1. Puye Conglomerate; Miocene-Pliocene, about one and a half miles west southwest of Socorro, New Mexico at a roadcut of U.S. Highway 60.

The widespread area in which these colored shales occur, the thickness of the formations, and the catastrophic implications of eruptive volcanic ash are obvious to creationists and evolutionists alike.*

Permian Conglomerates and "Talus"

The brecciated talus structure of the Permian El Capitan limestone mountains of New Mexico

*A personal communication from Donald W. Lane, Geological Survey of Wyoming, November 27, 1972, indicates that the primary source of the bentonite in the Colony, Wyoming area is the Lower Cretaceous Mowry shale. The Geological Map of Wyoming provides the following information:

Three Upper Cretaceous shales have bentonite beds: The Monument Hill bentonite beds and the Pedro bentonite beds of the Pierre shale and the Cody shale with many bentonite beds.

There are four bentonite shales in the Lower Cretaceous beds of northeastern Wyoming:

The Belle Foursche shale, which is black, soft with bentonite concretions.

The Mowry shale, which is black, hard, siliceous and weathers to silvery gray. It has many thin bentonite beds.

The Newcastle sandstone, which is gray with beds of sandy shale and some beds of bentonite and coal.

The Cloverly formation, which is a light gray to brown sandstone with lenticular pebble-conglomerate, interbedded with variegated bentonite claystone.

Volcanic eruptions throughout the Lower and Upper Cretaceous were therefore significant catastrophic events accompanying the extinction of dinosaurs in an increasingly unfavorable environment.

and western Texas have been well documented by Nevins.[3] Red Permian conglomerates of the same region have been associated with submarine turbidity currents and deposits.[4] Figure 1 shows a similar red, apparent Miocene-Pliocene conglomerate from about one to two miles west of Socorro, New Mexico.

Mid-continent Pennsylvanian Sediments

Pennsylvanian volcanism, mountain-forming intrusions, crustal faulting and severely disturbed and incomplete cyclothems are well established field observations. Even coal and sediment mixture was recognized by R. Feyes in 1961-1963 in explaining the distribution of illite clay. Illite is a 2:1, non-expanding clay derived from mica and feldspar minerals. Uniformitarianists recognize a "problem of illite" in the abrupt increase of illite from black shales (just above the coal) to comprise over 50% of the clay minerals of the gray shales and sandy shales above them. Feyes states:

> A fraction of these illite shales may have been formed from soils (15%-50%), but in this case they do not seem to present any distinctive compositional change due to pedological action. This fact also seems to favor the action of vegetation in the hinterland also subject to seasonal climate, the *reworking and mixing of the coal measure sediments before their final deposition* in the swamp with hygrophytes having as a consequence the *spreading of illite* more or less uniformly through the succession, whether or not a soil and vegetation is preserved at *the point of final emplacement.*[5]

Creationists agree with the concept of sediment mixing, but propose *tidal rafting* as the method of accumulation of coal-forming plants and shale forming clays. Even the black carbonaceous Pennsylvanian shale was deposited under disturbed environmental conditions. This is also recognized by Zangerl and Richardson[6]:

> The onset of the (ocean) transgressions produced an extremely sharp depositional change. Quite clearly this was not a gradual seeping of marine waters over the peat swamp, except along the most landward fringe, but very probably a sudden event accompanied with some degree of violence.

Then Zangerl and Richardson comment further:

> . . . This marine flooding was not merely the result of a major storm, although a storm or seiche may have accompanied the initial transgression thrust; we must assume that a sudden settling of the basin took place, caused most likely by increased tectonic activity. . . .[7]

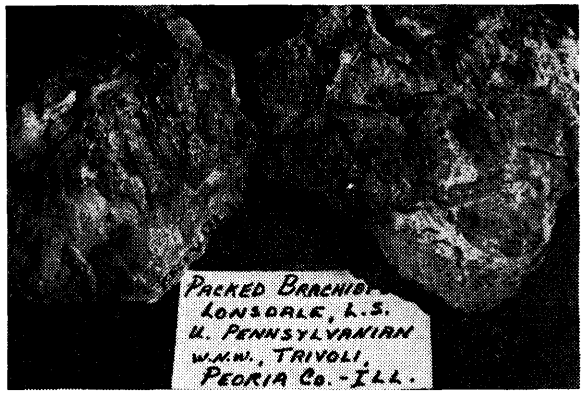

Figure 2. Randomly packed and distorted brachiopods in Lonsdale Limestone, Upper Pennsylvanian; west northwest of Trivoli, Illinois.

The cyclical and rapid deposition of Member 98 of the St. David Cyclothem of the upper middle Pennsylvanian System has been demonstrated by the writter.[8, 9, 10]

The tectonic agencies of catastrophic deposition are recognized by Moore[11], Dunbar and Waage[12] and in Kummels second edition of *History of the Earth.*[13] These include volcanism, block faulting, crustal sinking, folding, and intrusions. Moore recognized at least twelve episodes of crustal disturbances for the Pennsylvanian System alone.[14] These are reflected by the occurrence of over 100 incomplete cyclothems[15] in Illinois alone.

H. G. Coffin[16] very ably documented the catastrophic deposition of the polystrate Joggins tree trunks in the Nova Scotia sea cliff outcrops. Dunbar and Waage exhibit a photograph of these tree trunks in the 1969 edition of their *Historical Geology.* Kay and Colbert[17] speculated on the entrapment of salamanders within the hollow trunks of some of the trees. Even the Illinois Pennsylvanian limestones record rapid sedimentation. The Lonsdale Limestone of the lower McLeansboro Group (upper Pennsylvanian System) in western Peoria County, Illinois (Figure 2) shows distorted and randomly packed brachiopods.

Fossils are found in black shales of the Pennsylvanian series that should "not be there." For instance, the radiolarian, *Anthocyrtium* (Miocene protozoan); the protozoan foraminifera, *Nodosaria* (Triassic to recent), *Lituotuba* (Cretaceous), *Lagena, Bolovinina* and *Hyperamminoides* (Jurassic to recent); and the Conodonts, *Rhipidognathus*(?), and *Lonchodus* (Ordovician); *Trichonodella* (Devonian) and *Siphonodella* (Lower Mississippian) were reported as observed in Member 98 of the St. David Cyclothem.[18]

[Note: Photographs of the foraminiferan, ***Lituotuba*** (Figure 29; p. 43), the radiolarian,

Figure 3. Brecciated St. Louis Limestone, Middle Mississippian, east of Augusta, Hancock County, Illinois.

Anthocyrtium (Figure 91; p. 81) and the Conodonts, *Rhipidognathus* (Figure 35; p. 48) and *Lonchodus (Centrodus)* (Figure 76; p. 70) were presented as part of the Masters Thesis.]

The writer was advised at that time that even the *Treatise of Invertebrate Paleontology*[19] should not be considered the last word in paleontology. Yet each new secular biology, earth science, or geology textbook author treats as fact that animals and plants appeared in the geological time scale at specific succeeding "ages."

Mid-continent Mississippian Limestones

Mid-continent Mississippian limestones in Illinois exhibit rapid tectonic disturbances, The St. Louis Limestone (Figure 3) in a quarry east of Augusta in Hancock County contain several brecciated members. Northwest of Colchester, west central McDonough County a 15-foot member of the Burlington Limestone (lower Mississippian) in the Colchester Stone Co. quarry is severely conglomerated (Figures 4 and 5). Many of the clastics in this member are 15 to 20 inches and probably more in diameter. This limestone member was definitely fractured and recemented in a watery environment in a slurried condition.

Devonian Limestones

Strata of the Devonian System are well exposed in Central Western Illinois. They are referred to later in the discussion on the Ordovician.

Silurian "Polystrate" Fossils

After reading a fascinating article on Canadian Cambrian fossils by H. B. Whittington (see Reference No. 34 below) I examined several classroom specimens of Silurian Lockport dolomite. These rocks form spectacular cliffs east of Grafton in Jersey County, Illinois and overlook the Mississippi River. The trilobite, *Cala-*

Figure 4. Fifteen foot outcrop of slurried Burlington Limestone, Lower Mississippian; west of Colchester, McDonough County, Illinois.

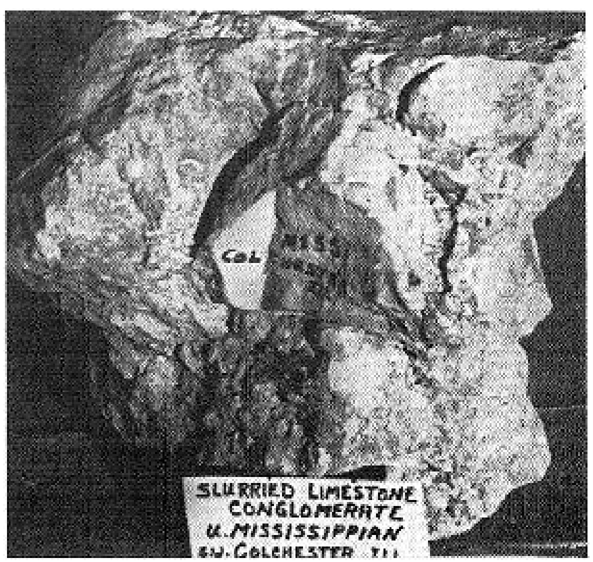

Figure 5. Closeup of slurried Burlington Limestone from outcrop west of Colchester, Illinois.

mene, is common in the lower portion of the outcrop. Figures 6 and 7 show specimens of the trilobite exposed in the dolomite samples. Three darker layers and a light layer below the fossil are labelled A, B, C, and D respectively.

Microlaminations were traced laterally from each of the fossils. Notice that the microlaminations truncate against the fossils, indicating a rapid sedimentation. Figure 6 shows two darker layers above the trilobite, which extends from a lighter layer D **into** the lowest darker layer C. Lines of other fine cavities (see arrow marks) seem to suggest cross-bedding, another suggestion of rapid sedimentation. In Figure 7, laminations traced by lighter colored microbedding planes have been traced with dark ink. These were traced around to the left face of the dolomite sample. The trilobite interrupts at least four microlaminations of solid dolomite. In the light of the later discussion of the Burgess Shale, catastrophic sedimentation of the Silurian Dolomite certainly seems warranted.

Catastrophic Ordovician Sedimentation

Ordovician limestones, dolomites, conglomerates, sandstones and folded rocks are directly associated with severe worldwide volcanism and crustal disruptions. Kay and Colbert in their textbook, *Stratigraphy and Life History* (Reference No. 17), display photographs of field evidence of catastrophism on pages 133, 135, 138, 139, 149, 159, 167, 168, 175, 176 and 179 related to the Ordovician System. In Illinois the Ordovician sediments also exhibit visible evidence of rapid sedimentation.

A large display sample (Figure 8) of Joachim Dolomite, lower middle Ordovician, from Batchtown, Calhoun County, Illinois clearly shows wave-marks. The lower ripple mark had a wave length of about five and one-half inches and was apparently moving toward the right. The upper wave-mark has a wave length of about nine inches and was apparently moving toward the left.

The trough of the upper wave-mark is distorted where the slurry flowed against and over a chert nodule. Notice that the cavity of the chert nodule (left side of Figure 8) shows microlaminations truncated at the edge of the cavity, which suggests that the chert nodule might have been transported to the deposition site.

Near the top of the dolomite section are at least two distinct layers of pulverized shells and calcite crystals. The base of the thicker layer of pulverized shells covered the finely rippled surface of buff dolomite (labelled R). The ripple wave length at this interface varies from half an inch to one inch, indicating a short period of settling and fine vibration. This was followed by several flows of pulverized shells. The cyclical series of dolomite and limestone is clearly visible on the highwall of the quarry.

Cycles of (a) silicon and magnesium or dolomite(?) alternating with (b) calcite or limestone are discussed in Nairn[20] on page 468 of *Problems in Paleoclimatology.* And R. W. Fairbridge[21] cited examples in the Appalachian Ordovician, mid-west Devonian, Belgium Devonian and Carboniferous, and Tertiary strata of Cuba and Jamaica. Further, Fairbridge quoted Landes' suggestion[22] of a ". . . rhythm of a sudden retreat and slow transgression of sea water," and also Rutten's suggestion[23] of a rhythmic sequence of ". . . alternation between storminess and calm sea conditions."

Significant criticism of orthodox uniformitarianism is published in the work edited by Nairn.[24] Bucher used four paragraphs to describe alternating shales and limestones in the Cincinnatian Series, Upper Ordovician. Bucher described both, a thin limestone-thicker shale formation and a thin limestone formation as ". . . formed by violent stirring up of the shale" (p. 595) and ". . . formed by exceptionally high storm-strengthened tidal currents and promptly covered by stirred-up shale settling on them." (p. 596)

All five series of strata of the Ordovician System are associated with volcanism, conglomerates and catastrophic deposition. It is therefore not surprising that the formation of dolomite itself is apparently far from settled. Donald H. Zenger of Pomona College stated last year that, in view of the many inconsistencies and disagreements between researchers, much work needs to be done concerning:

> . . . ordered dolomite versus protodolomite versus magnesium calcites; carbon and oxygen isotopes of dolomite crystals and their relation to primary or replacement dolomites; dolomite synthesis . . . kinetics of dolomite formation. . . .[25]

Widespread, violent volcanic eruptions and settling of dust rich in ferro-magnesians could supply the magnesium, and plagioclases could supply the calcium or sodium. Plagioclase feldspars supply both calcium and sodium: anorthite, 90% calcium; bytownite, 70%-80% calcium; labradorite, 50%-70% calcium; and andesine, oligoclase and albite supply increasingly larger per cents of sodium.

World-circling, continent covering gigantic tides could produce the cyclical sedimentary sequences and wave marks observed in the rock outcrops and quarries. Irregular seismic shock waves associated with crustal faulting could induce and accelerate differential compaction of freshly deposited sediments. All of these could contribute to the forces that induced continental drift as outlined by M. A. Cook[26] and could have

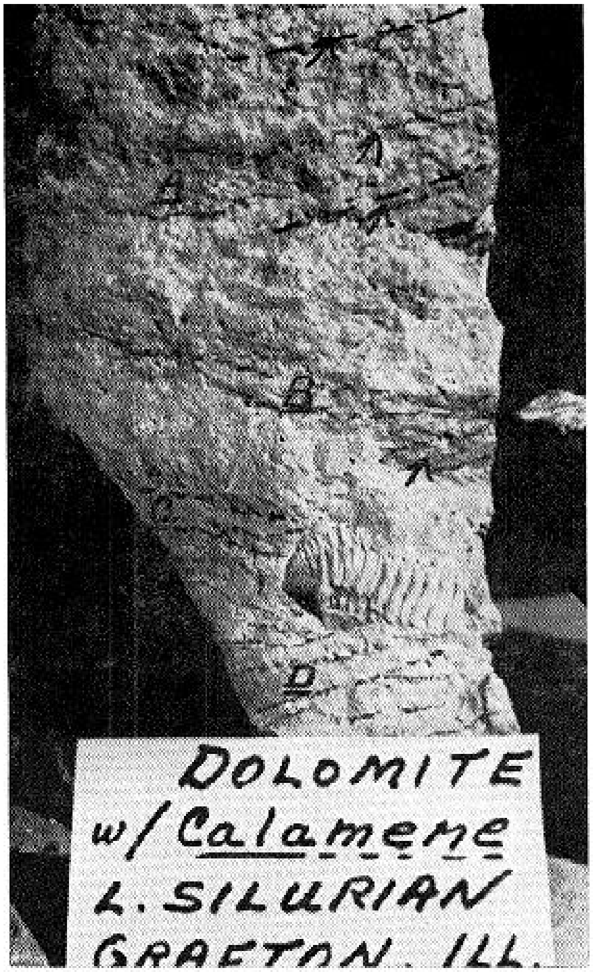

Figure 6. Trilobite, Calamene, in Lockport Dolomite, Silurian; three darker layers, A, B, and C. Fossil extends from layer D into layer C.

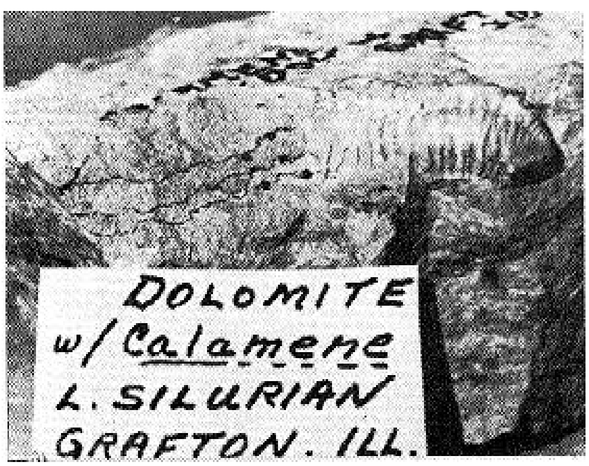

Figure 7. Trilobite, Calamene in Lockport Dolomite, Silurian; trilobite extends through at least four microlaminations, some of which are traced with dark ink to the left of the trilobite.

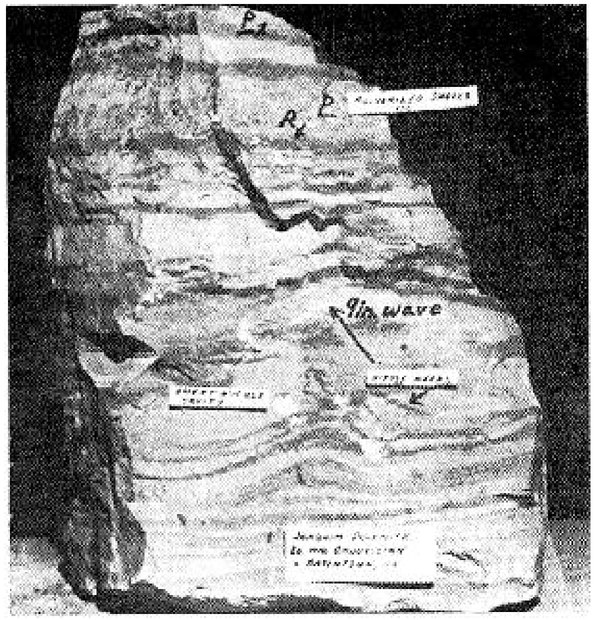

Figure 8. Joachim Dolomite, lower middle Ordovician; south of Batchtown, Calhoun County, Ill. Pulverized shells at P layers, nine inch and five and one-half inch wavemarks; and microlaminations truncated at chert nodule cavity.

accompanied the highest water levels of the Noachian Flood and its aftermath, as the waters receded and the Pleistocene ice age developed.

The deposition and composition of Paleozoic dolomites and limestones neatly coincide with the highest water levels of the Noachian Flood. Zenger cites the Ca-Mg ratios charted by Chilinger[27] as follows:

Table 1. Ca/Mg Ratios of Carbonate Rocks and Sediments vs Geological Age after Chilinger, 1956.

Age	No. of Samples Analyzed	Average Ca/Mg Ratio
Precambrian	70	4.0/1
Cambrian	40	4.2/1
Ordovician	100	3.5/1
Silurian	250	3.0/1
Devonian	160	7.0/1
Late Paleozoic	400	16/1
Cretaceous	85	56/1
Tertiary	50	53/1
Quaternary and Holocene	250	40/1

Standstones, shales and conglomerates dominate the Triassic and Jurassic sediments. If laboratory analysis bears out the same marked increase as in the Cretaceous, it would only emphasize more dramatically the radical change from Paleozoic sediments to those of the Mesozoic System; from Flood Epoch to Post-Flood aftermath, the "Age of Reptiles."

Such analysis would serve to reinforce the climatic suggestions of Northrup[28]: that the environment during the recession of the Flood was wind-blown, drying, and sandy in some regions, while receding tidal invasions still deposited limestones and chalks in others. There is evidence of "Triassic" subacarial lava flows with dinosaur prints between them and other differences contrasting Paleozoic with Mesozoic strata (personal communication from S. E. Nevins, Dec. 9, 1972).

The Ubiquitous Cambrian

Bernard Kummel[29] describes the Early Cambrian as follows:

> The miogeosynclines of the western and eastern sides of the continent were sites of extensive deposition of quartz sand derived in part from the central region, and since Middle Cambrian from areas on the seaward side of the troughs. In the eugeosynclines of eastern North America we find Lower Cambrian shales, graywackes and conglomerates.

The Mt. Simon in Illinois; the Marquette in Michigan, the McNaughton and Gog in British Columbia are the typical lowest Cambrian deposits in the "mid-continent." The Tapeats Sandstone marks the base of the Cambrian in Arizona. They form the Great Erosional Unconformity above the red sandstones, siltstones and shales of the Nankoweap formation of the "Lipallian Interval."

Beneath these are the greenish gray sills and dikes of the Rama diabase intruding through and above the bright red siltstones and shales of the Docks formation. Beneath are the other Precambrian metamorphics, conglomerates and igneous crystallines. Above are the basal sandstones of the Cambrian system.

From a Biblical perspective it is significant that the Precambrian "era" was buried under red shales, siltstones and sandstones, marking the end of a period of volcanic eruptions, igneous intrusions, volcanic sills, block faulting, rapid mountain forming and crustal rupture, the deposition of conglomerates and basaltic and felsic lavas. This seems logical because, on the day Noah and his family entered the ark: ". . . on that very day all the fountains of the great deep burst forth and the windows of heaven were opened."[30]

Perhaps it is more than coincidental that most of the early Cambrian deposits are sandstones. Only after the rains had carried the continental sandstones to the "outer edges of the central continental cratons" (platforms), would the waters of the Flood rise high enough to carry and deposit the dolomites, limestones and shales in gigantic slurries born within ever deepening tidal swells and waves over successively higher elevations until all the continents were submerged.

Cambrian Fossil Deposition

The presence of seedferns (Lepidophytes), horsetail trees (Calamites) and mosses (Bryophytes) and fragments of woody stems in the Cambrian have been discussed earlier by Rusch.[31] Pollen of evergreens (Conifers) and flowering plants (Angiosperms) in Cambrian and Precambrian deposits have been isolated evidently by Burdick and Loma Linda University workers.[32] However, another restudy project on the mode of sedimentation of Middle Cambrian deposits will be of special interest to C. R. S. *Quarterly* readers.

I was afforded a unique opportunity and pleasure July 6, 1972 to photograph specimens on 12 slabs of the famous Burgess Shales, Yoho National Park, British Columbia. Dave Nielsen, Park Naturalist, also gave me copies of three complete articles authored by Canadian and British geologists dealing with the tectonic and sedimentary aspects of the formation of the Middle Cambrian Burgess Shale at Field, British Columbia.

Photographs made from 35 mm color transparencies still illustrate the polystrate nature of the fossils in the Stephens Formation, *Ogygopsis* Shale of the lower middle Cambrian System from Mt. Stephen and Mt. Wapta.

Figure 9 shows *Ogygopsis* trilobite above and *Olenoides* below and to the right. *Olenoides* clearly interrupts a microbedding plane at point A. Figure 10 shows several sea worms (Polychetes) partially exposed. Notice that the lower (right or left hand) member of the paired appendages of the worms A and B are buried in the next lower bedding layer of shale and not visible.

H. B. Whittington of Sedgwick Museum, Cambridge, England, has presented[33] detailed microlamination and photographic studies of fossils in Burgess Shale. He has described carefully the orientation of the fossils, which extended through several bedding planes. None were within single laminations.[34]

Six to 39 per cent of the fossils were buried at angles oblique to the bedding planes. Five to 13 per cent ". . . of the individuals in the five samples taken from the 'Phyllopod bed' are

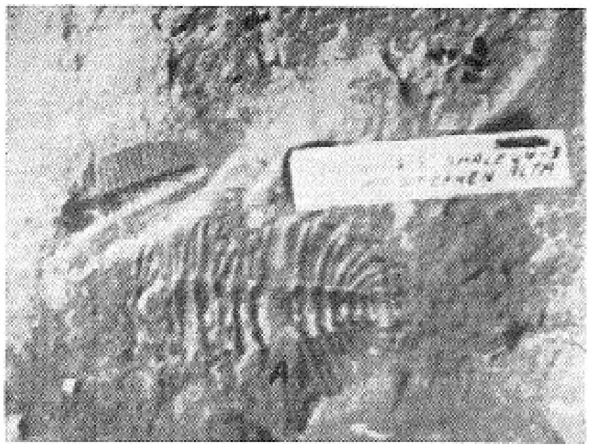

Figure 9. Burgess Shale, lower middle Cambrian from Mt. Stephens. Yoho National Park. south of Field. British Columbia, Canada. Point at which fossil; *Olenoides* (trilobite) extends from one lamination to another, marked A; Trilobite, *Ogygopsis,* above and to the left.

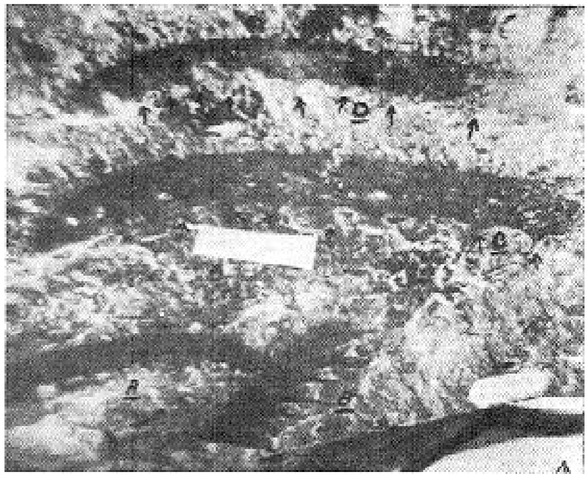

Figure 10. Portions of four polychete worms (Annelida) in Burgess Shale from Mt. Stephens. Yoho National Park, British Columbia. Worms buried lateral to bedding plane. Microbedding lamination (solid shale) separates paired appendages, covering buried member of pairs (A, C, and D).

compacted in an attitude approximately lateral to the bedding."[35] Whereas 56% to 81% of the specimens were parallel to the bedding planes:

> . . . It may be observed that the appendages do not lie in exactly the same bedding planes as the spines of the cephalic shield, but that they lie on different levels. The gill branches overlap one over the other, are inclined downward and forward relative to the cephalic spines, and there is a thin layer of rock separating them from the gill branches (Figures 8 and 9).[36]

Whittington used 18 photographs and six drawings to document his observations.

The mode of deposition suggested by Whittington is presented in several paragraphs.[37] In the first paragraph he states:

> A benthic population could have been catastrophically overwhelmed by a moving cloud of suspended sediment, the animals being entombed in a wide variety of orientations as the sediment settled. The delicate animals were not torn apart, but were buried with appendages such as gill branches and walking legs in natural relative positions, not twisted or disoriented.

He then suggests that they were buried only a short distance from where they lived by a slow moving current of sediment. However in the second paragraph he continues:

> A series of such catastrophic burials at irregular intervals could have produced the present fossiliferous layers (Figure 5). The chemical conditions that obtained in this sediment during diagenesis are problematical. Presumably the relatively rapid burial preserved the animals from predation, and there was little or no decomposition nor are signs of burrowing infauna.

In the third paragraph he suggests that the waters were relatively deep: ". . . (several hundred feet) off a limestone bank, an environment where a thick shale sequence was accumulating rapidly." Finally Whittington states:

> If the rare Burgess fauna and flora were a single community: . . . why are tracks, trails and burrows absent? . . . Favourable conditions for its burial and preservation occurred for only a short interval during the accumulation of a thick shale sequence.[38]

S. E. Nevins (in the same personal communication cited above) states that rapid burial such as this requires that the shale be formed from flocculated clay particles, distinctly unlike the deposition of modern red clays in ocean deeps from unflocculated clay suspensions. And Whittington re-emphasized his assertion of extremely rapid burial of the Burgess fauna in his 1971 report.[39]

Soft-bodied worms (Annelids and Polychetes), medusae of coelenterates, Arthropods including trilobites and sponges are among the 150 species found in the Burgess Shales. This unique formation is located on Mt. Stephens and Mt. Wapta, south and north (respectively) from Field, British Columbia in Yoho National Park. I climbed to the *Ogygopsis* shale on Mt. Stephen in July, 1972, but snow on the paths prevented any further hike to the Mt. Wapta outcrops.

Conclusions

The Paleozoic field evidence is found in quarries, erosion outcrops, fault-block mountains, folded metamorphuc rock series, and volcanic features. There are repeated evidences of cataclysmic forces and events. Integrated with the Genesis account of the Flood, they can provide very good visible evidence. Even the rocks "speak out" in testimony to the everlasting **truth** and veracity of the Bible. They can be used to form a firm foundation for the believer, and a formidable challenge to the unbiased scientist.

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