

ARTICLES

PRECAMBRIAN POLLEN IN THE GRAND CANYON — A REEXAMINATION

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WHAT THIS ARTICLE IS ABOUT

Primary in evolutionary thought is the concept that the geologic column has great validity. As geologists observe the rock strata around the globe, most would insist that its fossil record represents a description of life in the past. Implicit in this argument is the assumption that there is an orderly appearing of organisms from the more simple in the lower strata to the complex in the upper layers. This claim for orderliness in the fossil record has been challenged by creationists with claims of finding in the very lowest layers fossil remains of organisms that should have evolved hundreds of millions of years later. If such observations were indeed true, they would be a serious blow to the evolutionary concept. In the early sixties, Clifford Burdick claimed to have discovered pollen of modern plants in Precambrian rocks — rocks that were reportedly older than almost all known forms of life. Dr. Chadwick reexamines this claim. He has not been able to confirm Burdick's findings. However, Chadwick does point out that this type of irregularity in the fossil record has been reported by several traditional geologists and that these findings pose a challenge to one of evolution's fundamental tenets.

In 1966 C. L. Burdick published the remarkable claim that evidence exists for the presence of flowering plants in the lowest layers of Precambrian sedimentary rocks of the Grand Canyon. The magnitude of this claim can be more clearly understood by considering that the remains of vascular plants are almost unknown as fossils in the lower third of the Phanerozoic rock record, and that flowering plants are usually considered to be restricted to the Cretaceous and above. Burdick's evidence for the existence of these plants in the Hakatai Formation (Precambrian) was obtained from rocks lower in the geologic record than the remains of any previously reported vascular plant. During recent years, this paper has been cited on numerous occasions as a landmark for creationists (e.g., *Bible-Science Newsletter*, June 1981). Evolutionists on the other hand have by and large considered such results as an impossibility and have concluded, without seriously scrutinizing the data or reinvestigating, that his data resulted from contamination. Clearly such a discovery demanded both careful scrutiny and independent reinvestigation and, if authentic, deserved wide publicity. However, no such detailed account has yet been reported. Thus a careful reevaluation is in order and is long overdue.

In 1971 I obtained a collecting permit from the National Park Service and accompanied C. L. Burdick to the Grand Canyon. His previous sample localities were relocated and new samples were collected, returned to my

laboratory at Loma Linda University and processed by C. L. Burdick using techniques similar to those he had employed in his earlier work at the University of Arizona. On the basis of results from these samples, Burdick (1972) published a second paper claiming substantiation of his earlier paper. It is unfortunate that Burdick chose to publish the results of this work without waiting for independent confirmation. In this second article, as in the first, he figures several objects which are not identifiable and several pollen grains which are either modern or of modern affinities. However, he made the claim [challenged in a subsequent cautiously worded report (Chadwick, DeBord & Fisk 1973)] that these data supported his previous findings. In a sense they do, in that both papers figure grains which are clearly modern in aspect and indistinguishable from grains abundant in the present pollen spectrum of the Grand Canyon region. However, the conclusion that these findings support the concept of Precambrian higher plants is a *non sequitur* until all cause for concern regarding modern contamination has been eliminated. It was with this goal in mind that the work reported herein was undertaken.

MATERIALS AND METHODS

A second trip was made to the Grand Canyon in 1972. The collection sites described by Burdick were relocated and samples taken. Two subsequent trips were made to obtain additional samples. Particular attention was paid to the collecting and storing of materials so as to prevent field contamination. In the laboratory the samples were thoroughly washed using filtered water and soap, then all external surfaces were removed using a trim saw with non-recirculating coolant. The entire external surface of the freshly exposed rock was scrutinized to eliminate samples with microfractures or other flaws. Processing was by standard techniques (e.g., Doher 1980), except that unusual precautions were taken to prevent contamination. All solutions were filtered, the room was maintained under positive pressure with a filtered air supply, and all glassware was scrupulously cleaned using filtered water and soap. Special recovery techniques were employed to prevent accidental loss of material during processing (Chadwick 1980).

Slides were scanned in their entirety with overlapping scans at a magnification of approximately 200 and 500 \times . Records were made of any material of biologic or suspected biologic origin.

RESULTS

A total of fifty samples from the same strata which Burdick had studied were processed. All slides were completely scanned. No single example of an authentic pollen grain was obtained from any of these samples. In fact, the slides produced from the Hakatai Formation were in most cases completely free from any material of biologic origin, modern or fossil.

DISCUSSION

Before considering the implications of the above findings in relation to the data presented by Burdick, let us briefly review a little of the sedimentary history of the Grand Canyon.

The walls of the Grand Canyon expose rocks ranging from Permian at the top to Precambrian at the base. Below the Cambrian Tapeats Sandstone, the first layer containing the authentic remains of metazoan fossils, lie 12,000 feet of sediments which in nearly every detail but one are similar to various sediments found higher up in the rock strata. That one detail is the absence of the indisputable remains of metazoan life forms in the Precambrian rocks.

The Hakatai Formation from which Burdick obtained his samples occurs in the lower portion of this section. Almost 10,000 feet of Precambrian sediments separate this deposit from the first rocks (Tapeats Sandstone) containing the undisputed remains of metazoan life. Prior to the deposition of the Tapeats, these Precambrian sediments were lithified, tilted and eroded away to a depth of over two miles in places. The evidence that these Precambrian sediments were already hardened into stone before their uplift and erosion is clear: large angular fragments of indurated and fused quartz sand from the Precambrian Shinumo Formation (which overlies the Hakatai Formation) were incorporated into the Tapeats Sandstone.

The scenario required by Burdick's data, if correct, is as follows. First, Hakatai mud accumulates. As it does so, grains of pollen from conifers, ephedra, composites and other plants similar to those found presently at the Grand Canyon fall into the mud and are buried. Subsequently nearly 10,000 feet of sediment accumulate on top. These layers become subjected to diagenetic alteration and are converted into hard rock. The layers are uplifted and tilted, and two miles of solid rock and sediment are eroded away over large portions of the Colorado Plateau. Then the influx of sediment begins again as the Cambrian sediments accumulate, and this time abundant remains of living organisms are preserved.

The simplest hypothesis to explain Burdick's data is that the pollen grains he reported in 1966 and in 1972 were modern contamination picked up either during collection and transportation or infiltrated into the sample itself prior to collection. Palynologists are well aware of the constant danger of contamination at all stages in sample collection and preparation. The kind of questions one asks when faced with this possibility are as follows:

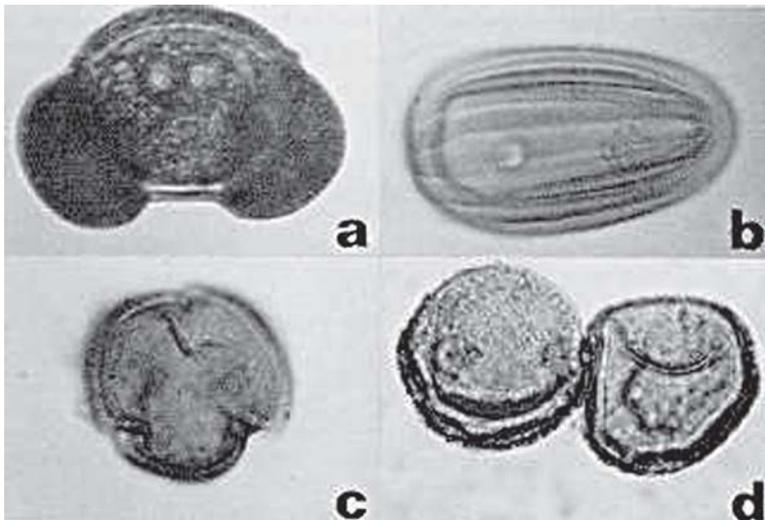
1. do the pollen and spores found in the sample match grains from modern plants in the area?
2. does the preservation of the grains accord with the level of preservation of other organic material in the sediments?

- do the grains make good sense in the stratigraphic setting in which they were found?

With respect to these questions we can draw the following conclusions from Burdick's papers.

- No rigorous attempt was apparently made by Burdick to evaluate personally the modern pollen rain in the Grand Canyon. A single sample of soil from near one of the collecting sites could have completely satisfied Burdick as to the source of most of the grains he has reported. A typical analysis of a site near where Burdick collected his Hakatai samples yielded the following profile: bisaccate pollen (conifers) 30%; juniper 12%; ephedra 16%; various species of angiosperms (42%) (Sigels 1971). Although the poor quality of the photographs in the plates of Burdick's first paper makes definite assignments impossible, one can approximate the composition of the flora he reports. Of the grains identifiable as pollen or spores in the two papers by Burdick (n=18), 7 or 37% are bisaccates, 2 or 11% are possibly juniper. Ephedra pollen constitute 11% and angiosperms and unassignable grains 34%. Thus even with this small sample

FIGURE 1(a-d). Some typical modern pollen types from tree species presently growing in the Grand Canyon region. (a) *Pinus* sp., cf. Burdick 1972, figure 3; (b) *Ephedra nevadensis*, cf. Burdick 1972, figure 5, also Plate I, figure 3, probably *Ephedra torreyana*, the other *Ephedra* species in the Grand Canyon; (c) *Quercus* sp., cf. Burdick 1966, Plate IV, figure 4; (d) *Juniperus scopularum*, cf. Burdick 1966, Plate II, figure 4.



size, Burdick's grains approximate the modern pollen rain found in surface samples *in the area of the Grand Canyon where he collected his samples.*

2. The preservation of the grains which Burdick figures in his first paper is difficult to estimate because of the poor quality of the photos. In the second paper the grains appear nearly fresh. The complete absence of organic material other than the pollen and spores cited by Burdick makes comparisons difficult, but many analyses from other Precambrian rocks where organic remains are thought to occur reveal little more than carbon films. Considering the deep burial, lithification, and oxidized condition of the Hakatai shales, the state of preservation of these grains suggests that they were not a part of these sediments during their diagenesis. Incidentally, the red color of the grains, cited by Burdick as an indication of their antiquity, if not due to laboratory staining procedures commonly employed, is in any case not necessarily an indication of antiquity since the ferruginous stain in the rocks can be readily acquired (as any Grand Canyon hiker will testify).
3. While one may tend to consider the third point as introducing bias, only a tyro of earth history would lay aside the general orderliness of the stratigraphic record as meaningless. Clearly the general absence of the remains of higher land plants from the Precambrian and lower Phanerozoic rock record does have meaning. It does not however indicate that the plants were not on the earth somewhere contemporaneously, since it is also possible that they were not often preserved or incorporated into the rocks. More difficulties are created than are solved by Burdick's report since it would require the explanation of the accumulation of all the Upper Precambrian sediments (10,000 ft.), their lithification and subsequent erosion before the first additional fossil forms were buried. Add to this picture the many thousands of macerations of lower Paleozoic and Precambrian rocks which have been carried out in scores of palynology laboratories around the world which have not supported Burdick's claims. There is a general absence of evidence for flowering plants below the middle Cretaceous. It is a responsibility and challenge to creationists to develop a model of earth history which explains this absence.

Unfortunately it is not an easy task to correct a positive report such as Burdick's with negative data. In our hands, application of the cardinal principle of the scientific method — reproducibility — has failed to authenticate his record. Thus the hypothesis that the grains are authentic

examples of Precambrian pollen can only be treated with incredulity at present, even among creationists.

ONE POSITIVE NOTE

Although there may not be evidence for Precambrian pollen in the Grand Canyon, there is one thoroughly documented report of the occurrence of pollen and vascular tissue of higher plants which does support the existence of angiosperms earlier in the fossil record. The story surrounding the discovery of authentic higher plant remains in the Saline series of the Salt Range in Punjab, India, and its subsequent elaboration is anecdotal but nevertheless is worth investigating. Although the subject of the Salt Range beds is proscribed among Indian and many western paleontologists today, the case rests precisely where it did 30 years ago (Ghosh, Sen & Bose 1951). The fossils are modern in aspect (“Eocene” according to Sahni 1944) yet the beds containing the fossils are overlain conformably by early Cambrian sediments (Coates et al. 1945). Creationists who wish evidence for the existence of angiosperms early in the fossil record should cite this well-known case.

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