

GEOSCIENCE REPORTS

SPRING 2002

No. 33

THE GEOLOGY OF MOUNT CARMEL, ISRAEL

Elaine Kennedy, Geoscience Research Institute

Introduction

Most of us are familiar with the story of Elijah standing on a mountain top, calling down fire from heaven. The biblical account states that Elijah's experience occurred on Mount Carmel.¹ Today it is rather difficult to pinpoint the exact location of Elijah's confrontation with the pagan priests, because there is no specific peak called Mount Carmel; instead there is an isolated line of hills that form outcrops of what is thought to be an ancient carbonate barrier reef.² The mountains of Carmel rise above the sea near the west coast of Israel (Fig. 1).

Structure and stratigraphy

In central Israel the Judean-Ephraim Hills are interpreted as an uplifted and eroded marine, carbonate shelf. To the northwest of this range of hills is the area known as Mount Carmel (Fig. 2). The Carmel region is bounded to the northeast by faults, and on the southeast by the Ramat Menashe syncline (Menashe Plateau). The western side has been shaped by sea level fluctuations during the Pleistocene.^{3,4,5} The hills consist of upper Cretaceous (Table 1) chalks, limestones and dolomites. The frequent changes in the rock relationships that form



Figure 1: Caves in Mt. Carmel have evidence of Paleolithic habitation. Archaeological research is ongoing. Photo by author.

complex structural components on Carmel suggest reef formation at the



Figure 2. Location of Mt. Carmel region in northern Israel.

edge of a carbonate shelf.^{6,7} The upper Cretaceous carbonate system overlies the Cambrian through lower Cretaceous "Nubian" Sandstone with a few exceptions where the carbonates directly overlie the crystalline, Precambrian basement rock (Table 1).

Across Israel facies changed during a series of depositional cycles. In each of three main cycles in the upper Cretaceous, multiple environments were receiving sediments: the carbonate shelf (Judean Hills), reefs (Helez, Carmel and Nahal Hamea'rot), slope (coast of Israel) and the Tethyan basin

Continued on Page 2

Continued from Page 1

TABLE 1. THE GEOLOGIC COLUMN		
ERA	SYSTEM OR PERIOD	SERIES OR EPOCH
	Quaternary	Holocene(Recent) Pleistocene
Cenozoic	Neogene Miocene Tertiary	Pliocene
	Paleogene	Oligocene Eocene Paleocene
Mesozoic	Cretaceous	Upper, Lower
	Jurassic Triassic	Upper, Middle, Lower Upper, Middle, Lower
Paleozoic	Permian Carboniferous	
	Pennsylvanian Mississippian	Upper, Middle, Lower Upper, Lower
	Devonian	Upper, Middle, Lower
	Silurian	Upper, Middle, Lower
	Ordovician	Upper, Middle, Lower
	Cambrian	Upper, Middle, Lower
	Precambrian	Upper, Middle, Lower

(offshore).^{8,9} Due to the complexity of the system, correlation has been difficult. The correlations between the northern and southern Carmel areas rely on the field relationships of the rock units, fossils and volcanic horizons.¹⁰ In general, chalks dominate the “fore reef” region at Carmel, limestones are found in the “reef core” and dolomites form the “back reef” deposits. These deposits represent the most complete reef system in Israel.

While climbing the stairs on the hillside (Fig. 1) at the Nahal Me’arot Visitor’s Center, one cannot help but notice the fossils in the limestone outcrops. The variety of broken fossil fragments on what would have been the seaward side of a barrier reef suggests a hash that could have been produced by storm systems sweeping across the areas. A resistant reef would absorb most of the energy of the storm waves, protecting the shelf region. The storms could also account for each hiatus of limey muds and fossil hash found

between the levels of rudistid colonies. These features can be seen inside the caves on Mount Carmel where the structure of the massive limestones (reef core?) can be observed (Fig. 3). The eastern area is composed of the bedded dolomites and covered with vegetation.

Paleontology

Mount Carmel is described in the literature (see references) as a rudistid reef that formed along the outer shelf/slope region. Rudistids are an unusual type of pelecypod (phylum Mollusca). The best known of the pelecypods are the clams (the genus *Pecten* is the Shell Oil Company symbol) and oysters. Rudistids are elongated, cone-shaped organisms that look strikingly similar to horn coral (for on-line photographs, visit <<http://www.humboldt.edu/~natmus/Exhibits/listing.html>>).¹¹ They grow on top of each other to form interlocking clusters that may have formed an effective wave-resistant barrier or patch reef.

Alternating layers of upright rudistid clusters and thick sections of limestone that were deposited with only scattered fossil fragments are typical of this deposit (Fig. 3). Brachiopods, echinoids, microfossils, fish fragments and reptile bones are also found in the reef. Gastropods (snails) are common but corals are extremely rare.¹²

Additional Notes

It should be noted that most of the rudistids are not *in situ* i.e., in growth position, and have almost no encrusting organisms.¹³ This is not typical of modern reefs. There is no hiatus in the deposition of the limestones at the base of the rudistids and this suggests that rudistid growth did not require a hard substrate for the attachment and growth of these organisms.¹⁴ It was not possible for us to examine the basal contact of the deposits at Mount Carmel; however, it has been noted in the

Continued on Page 3

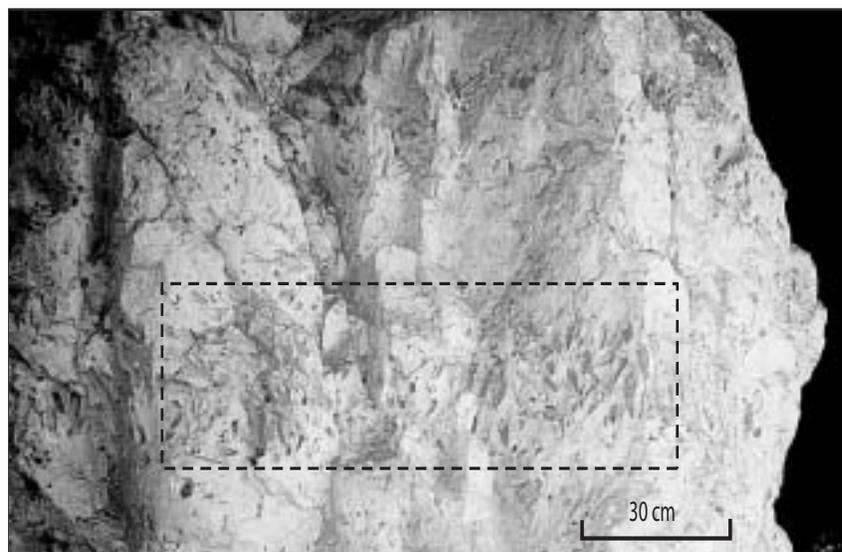


Figure 3. Limestone “reef core” structure. A prominent layer of rudistid clusters can be seen in the dotted box. Overlying layers of limey muds contain scattered and broken fossils. Photo courtesy of the author.

Continued from Page 2

literature that lower Cretaceous dolomites have been found elsewhere at Mount Carmel.¹⁵

Comments

The most interesting aspect of the regional geology is the disruption of Israel's carbonate facies by these isolated mounds of rudistids along the western coast. Another interesting feature is the one exposure that we saw of a succession of rudistid layers that appear to be *in situ*. While these layers are unique to the deposit since most of the rudistids are not in growth position, their relationships with the intervening limestone deposits suggest periods of growth punctuated by storm deposits. It is also possible the section is part of a large boulder in a massive storm or slide deposit on the outer "shelf/slope" area. More research needs to be done in these areas.

Endnotes

1. 1 Kings 18.
2. Sass E, Bein A. 1978. Platform carbonates and reefs in the Judean Hills, Carmel and Galilee: Tenth International Congress on Sedimentology, Jerusalem, Post-Congress Excursion Y6:249-255.
3. Ball M, Ball D. 1953. Oil prospects of Israel. American Association of Petroleum Geologists Bulletin 37:1-79.
4. Sass & Bein, p 249 (see Note 2).
5. Weinstein-Evron M. 1998. Early Natufian el-Wad revisited, Eraul 77, Liège, Belgium. 265 p.
6. Sass & Bein p 249 (see Note 2).
7. Weinstein-Evron, p 27 (See Note 5).
8. Bein A. 1976. Rudistid fringing reefs of Cretaceous shallow carbonate platform of Israel. American Association of Petroleum Geologists Bulletin 60:258-272.
9. Weinstein-Evron, p 27 (see Note 5).

EDITOR'S ANGLE



During August of 2001, Drs. Ben Clausen, Kevin and Jan Nick, and I looked at the geology of Israel, Jordan (Petra), and eastern Sinai. One of the most interesting stops was at Mt. Carmel, southeast of Haifa. Here we had a wonderful opportunity to study an area that is believed to be a rudistid reef (see main article). Much of the reef front has been eroded away and the back reef area is under vegetation; however, we were able to inspect the interior of what has been interpreted as the reef core inside several caves on the hillside.

Later in our excursion, we made our way with scuba gear and snorkel at Dahab in Sinai Egypt to look at a modern patch reef. This modern reef has an abundance of corals and significant siliciclastic input. Some reef areas covered a sizeable area, while others were small isolated clusters of organisms. The conditions were perfect: gentle current,

no jellyfish, no sharks, cool water and plenty of sunshine. We saw a wide variety of fish and coral. Sea urchins were abundant.

Although the ancient and modern environments we looked at were very different biologically and geologically, the distribution of the organisms on the patch reef-like structures near Dahab brought to mind the horizons of fossiliferous



Reef in Gulf of Aqaba at Dahab, Sinai, Egypt. Photo courtesy of E. Kennedy.

clusters of organisms at Mount Carmel. — EK

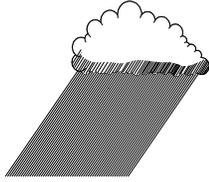
* * * * *

10. Sass & Bein, p 249 (see Note 2).
11. Moore R, Lalicker C, Fischer A. 1952. Invertebrate fossils. NY: McGraw-Hill Book Co., Inc. 766 p.
12. Bein, p 258-260 (see Note 8).
13. Ibid., p 258.
14. Ibid.
15. Folkman Y, Lasman N, Raab M. 1966. Lower Cretaceous outcrops on Mount Carmel (Northern Israel). Israel Journal of Earth-Sciences 15:38-41.

* * * * *

NOTES FROM THE SCIENTIFIC LITERATURE

PALEO-CLIMATE



Loope D, Rowe C, Joeckel R. 2001. Annual monsoon rains recorded by Jurassic dunes. *Nature* 412:64-66.

For decades scientists have discussed the evidence for wind-blown versus water-laid deposition of the Jurassic Navajo Sandstone. In this paper the authors have reported both wind-blown and water-laid structures in the Navajo at 24 localities in the southwestern U.S. They submit that the deposits contain evidence of seasonal rains, including summer monsoons, that clearly define annual cycles of deposition.

Comment: Although this model significantly reduces the time-frame for the deposition of the Navajo, one of the photos accompanying the article shows nine deposits of sand separated by thin beds of mud. According to the authors, each mud/sand unit represents one year of deposition. If this is true, it would be problematic for flood modeling of the Jurassic sediments in that region. However, it is also possible that the ebb and flow of flood waters mimicked what scientists believe could be annual depositional cycles.

**Visit us thru
cyberspace
on our website at:
<http://www.grisda.org/>**

Rempel A, Waddington E, Wettlaufer J, Worster M. 2001. Possible displacement of the climate signal in ancient ice by premelting and anomalous diffusion. *Nature* 411: 568-571.

The ice sheets of Greenland and Antarctica contain an extensive network of veins of liquid water that form along the ice grain boundaries. This water forms an anomalous, diffusive conduit for soluble impurities, transporting the trace constituents that are used to determine the paleoclimates of the ice layers. Researchers documented migration up to 50 cm. The researchers note that this migration distance challenges the proposed cooling events that have been reported by others. In addition, the authors suggest that this diffusion can displace the chemical markers that are used for stratigraphy and correlation of time scales between cores.

GEOSCIENCE REPORTS Spring 2002 No. 33
©Geoscience Research Institute 2002

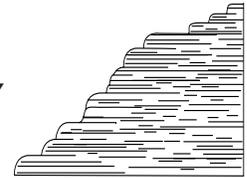
Editor Elaine Kennedy
<ekennedy@univ.illu.edu>
Associate Editor Katherine Ching
Subscription requests, correspondence, and notices of change of address should be sent to: Publications Editor, Geoscience Research Institute, 11060 Campus Street, Loma Linda, CA 92350 USA. Annual subscription rate is \$3.00 (U.S. currency only).

Geoscience Reports is a newsletter published by the Geoscience Research Institute to present current happenings at the Institute as well as general-interest articles that deal with creation/evolution issues for elementary/secondary-school and college science classes. The views expressed are those of the authors and not necessarily those of the Institute.

Staff of the Institute: L James Gibson, Director (PhD, biology); Ben L Clausen (PhD, nuclear physics); Radl Esperante (PhD, vertebrate paleontology), Elaine Kennedy (PhD, geology); Katherine Ching, Editor (MA, history); Timothy G. Standish (PhD, molecular genetics); and Janet Williams, Administrative Secretary.

Comment: This paper challenges a fundamental assumption of ice core research, i.e., chemical markers for paleoclimate determination experience limited migration after deposition, by documenting the migration within ice cores in central Greenland.

GEOLOGY



Moore E. 2002. Pre-1 Ga (pre-Rodinian) ophiolites: their tectonic and environmental implications. *Geological Society of America Bulletin* 114:80-95.

Ophiolites are interpreted as magmatic oceanic crustal materials that are believed to represent an ancient, failed subduction zone that resulted in a collision of an island arc or continental margin.

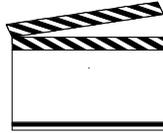
The geochemical composition of ophiolites dated at 1 Ga suggest an abrupt thinning of oceanic crust. The author cites other researchers that have proposed in several papers the time synchronous drop in sea level/rise of continents, the origin of seasons and the postulated increase in atmospheric oxygen.

Comment: The author challenges the "static earth model" (previously proposed for the entire Precambrian) for the Neo- and upper Mesoproterozoic ophiolites and promotes non-uniformitarian explanations for the abrupt change in igneous, tectonic and environmental processes. Other unique events have been postulated for rock-forming processes in the lower Proterozoic.

* * * * *



RECOMMENDED VIDEO



Unlocking the Mystery of Life: The Scientific Case for Intelligent Design. Produced by Illustra Media, 2002. 65 Minutes, \$24.95. Order info: <www.illustramedia.com>.

Reviewed by Tim Standish

Unlocking the Mystery of Life is what all science videos should be. It is interesting, lacks the typical "nails-on-a-chalkboard" soundtrack, sets the historical and social context of the questions being discussed, has beautiful cinematography and production values, features fascinating thinkers and has fantastic graphics. The miracle of all this is that it deals with the origin of life and does it from the perspective of real science, not as an instrument of indoctrination into the philosophy of naturalism.

This video should be shown in every Christian high school biology classroom. No, it should be shown in *all* high-school biology classes! If they have not already seen it, freshman college biology students would also greatly benefit from viewing this video.

All the major players in the Intelligent Design movement are featured and elegantly present their arguments for design. Probably the most powerful example I have ever seen of a scientist letting the data drive his thinking is the way in which this video depicts the intellectual journey of Dean Kenyon. Kenyon is a leading chemical evolution theorist and coauthor of *Biochemical Predestination*, a seminal work on this topic. As the result of one student's unanswerable question and the subsequent accumulated data, Kenyon has revised his opinion that life could be produced via spontaneous chemical reactions. Instead he now believes the data point toward intelligence behind the creation of living things.

If there is a problem with *Unlocking the Mystery of Life*, it is that the graphics are so astonishingly good. Viewers may find it necessary to watch the video several times to get past being amazed by what the producers did and actually listen to the logic of the arguments being

Tambien Disponible

Desde 1982, el Instituto de Investigación en Geociencia viene publicando un periódico tres veces al año en español. Se llama "*Ciencia de los Orígenes*" y su redactor es el Dr. David Rhys. Esta breve publicación trata sobre los diversos temas relacionados con los orígenes.

La suscripción es de \$1.50 en los EEUU y México. Para los demás países es de \$2.50.

El pago se puede hacer con cheques u órdenes de pago en dólares (no estampillas) a "*Ciencia de los Orígenes*," Geoscience Research Institute, 11060 Campus Street, Loma Linda, CA 92350 USA.

made. A teacher could spend months trying to convey how genes are transcribed and translated, a task achieved by the producers in minutes using three-dimensional computer generated graphics. Anyone planning on using this video in biology classes should do their lecturing on transcription and translation first if they want students to be listening. After seeing it, students will have a firm grasp on the topic.

Unlocking the Mystery of Life gives a clear and fair explanation of Darwin's ideas, which must be understood first if one is to grasp why they do not account for what we see in nature. Such concepts as irreducible complexity, molecular machines and the amazing information content of cells are masterfully presented. *Unlocking the Mystery of Life* represents a powerful educational tool in the arsenal of those seeking to promote clear thinking when addressing questions about the origin of life.

* * * * *

"Evidences: The Record and the Flood"

is the winner of a Silver Screen award.

This 45-minute video (with a companion all-color magazine) is available in VHS or PAL format for U.S. \$29.95 + shipping.

To order your copy,
contact your local Adventist Book Center
or
the Review and Herald Publishing Assn
55 W Oak Ridge Dr.
Hagerstown MD 21740 USA
Telephone: (301) 791-7000

A Teacher's Guide is available from the GRI

FROM THE GEOSCIENCE RESEARCH INSTITUTE MUSEUM

The Jurassic Solnhofen Limestone

Katherine Ching, Geoscience Research Institute

Fossils (preserved plant and animal life) have been found throughout the world and are considered to be indicators of past life on Earth. The most commonly preserved fossil parts are shells and bones — the hard tissues.

Trace fossils include fossilized trails, burrows, tracks — structures resulting from the organism's activity or impact on its surroundings.

More information can be learned from intact body fossils of either plants or animals. Body-fossil preservation requires special environmental conditions; for example, rapid burial in sediments, anaerobic conditions to reduce the rate of decomposition (bacterial decay), pervasive mineralization to maintain the integrity of the fossil structure, and a relatively stable post-burial environment.

Of especial value to paleontologists and others who seek to learn about the past history of life on Earth are the *Konservat-Lagerstätten*, the “lode places” where abundant deposits of exceptionally preserved, widely diverse fossil assemblages are found — even delicate, soft-bodied organisms that usually leave, at best, fragmentary traces of their existence.

Lagerstätten are found in many parts of the world in different geologic systems: e.g., the Precambrian Ediacara Hills in South Australia; the Cambrian Burgess Shale in British Columbia, Canada; the Cambrian Chengjiang in the Yunnan Province, China; the Devonian Hunsrückschiefer in Germany; the Pennsylvanian Mazon Creek in northern Illinois; the Cretaceous Santana Formation in

northeastern Brazil; the Eocene Messel Oil Shale in Hessen, Germany; the Eocene Green River Formation in the Rocky Mountains, USA; the Miocene Ashfall Fossil Beds in Antelope County, Nebraska; the Pliocene Vera Basin in southeast Spain; and the Pleistocene La Brea (“Tar Pits”) near Los Angeles, California.

One of the best-known sites for *Lagerstätten* is the Jurassic Solnhofen Limestone in Bavaria, Germany. The main article from an earlier issue of *Geoscience Reports* (#30, 2000) described Solnhofen in connection with *Archaeopteryx*, the part-reptile, part-bird, part-dinosaur creature that has been interpreted as an evolutionary link between dinosaurs and birds.

Although *Archaeopteryx* has, perhaps, received the most attention, various other fossil types are represented from Solnhofen. Among the plants are algae, ferns, gymnosperms, ginkgo, and conifers. Invertebrate animals include sponges, ammonites, corals, worms,

brachiopods, molluscs, crustaceans, and echinoderms. Insects such as beetles, cicadas, and dragonflies are clearly recognizable. Fish, birds, and reptiles comprise the vertebrate fossils.

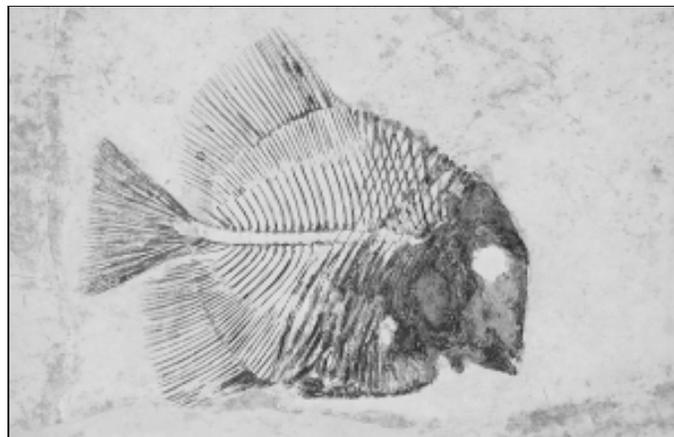
The Geoscience Research Institute has added some of these Solnhofen fossils to its collection, to be placed on display for our visitors. Although the black-and-white photographs do not do justice to the amount of amazing detail that can be seen at close range, we thought our readers would enjoy seeing some of the variety of Solnhofen fossils.

For further reading:

Barthel KW, Swinburne NHM, Conway Morris S. 1978 (English translation, 1990). Solnhofen: a study in Mesozoic palaeontology. NY, Cambridge, and Melbourne: Cambridge University Press.

Frickhinger KA. 1999. The fossils of Solnhofen 2. Korb: Goldschneek-Verlag.

* * * * *



Gyronchus macropterus. Length from tail to head is 12 cm.

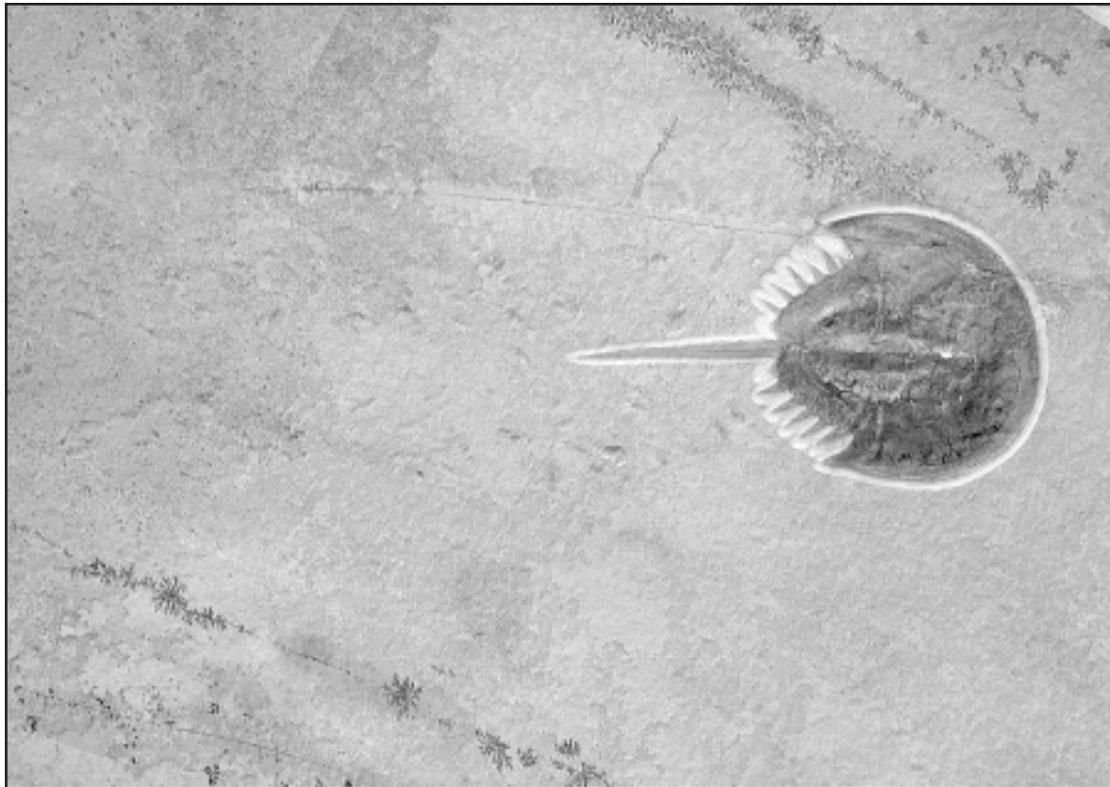
Continued from Page 6



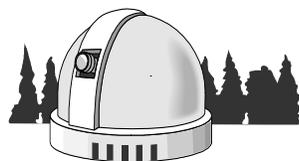
Tharrophlebia. A dragonfly with nicely spread wings (wingspan = 11 cm).



Antrimpos speciosus (shrimp). The body of the shrimp is 17 cm long.



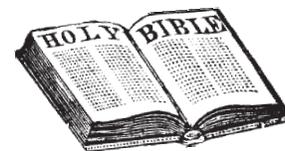
Mesolimulus walchi. The final tracks made by the horseshoe crab can be seen to the left of the fossil (15 cm in length, including tail tip).



WOMEN OF SCIENCE AND FAITH IN GOD

SUSAN JOCELYN BELL-BURNELL (1943-)

Benjamin L. Clausen, Geoscience Research Institute



S. Jocelyn Bell was born into a family that was part of the Religious Society of Friends (commonly known as Quakers). Her secondary education was at a Quaker boarding school for girls in York, England. In 1965 she earned a BSc at the University of Glasgow, and in 1968 a PhD at Cambridge University.

While a graduate student at Cambridge, Bell built a radio telescope under the supervision of her professor, Antony Hewish. While taking data, she detected a rapid set of pulses at regular intervals. Their source appeared to be fixed with respect to the stars, and they quickly ruled out various possibilities, including “Little Green Men.”

Within the next few months, Bell detected four of these “pulsars,” later determined to be neutron stars. These rapidly rotating stars, with a mass approximately that of the sun shrunk to the size of a city, make a complete revolution in a few seconds or less. As they rotate, a beam of radio waves flashes by, just as from a lighthouse beacon. They provide clues to the life history of stars.

Antony Hewish shared the 1974 Nobel Prize for the discovery of pulsars with Sir Martin Ryle. Sir Fred Hoyle and others argued that Bell-Burnell should have shared in the Prize, as well.

Over the years Bell-Burnell has been awarded several honorary doctorates and received other recognition: the Michelson Medal, the Oppenheimer Prize, and the Tinsley Prize in the United States, as well as the Herschel Medal in the United Kingdom.

In 1969 Bell-Burnell became a member of the Royal Astronomical Society and from 1995-1997 served as vice-president. In 1995 she received the Jansky Lectureship in the USA and in 1999 toured Australia giving the Women in Physics Lecture. She has worked on gamma-ray astronomy at the University of Southampton, x-ray astronomy at University College London, infrared astronomy at the Royal Observatory, Edinburgh, as well as in management of the Maxwell Telescope in Hawaii. Her interests also include encouraging a public understanding of physics and astronomy. In 1991 she became Professor of Physics and head of the Physics & Astronomy Department of the Open University, the largest institution of higher learning in the United Kingdom, and a “second chance” for many non-traditional students. During the 1999-2000 school year she was Distinguished Visiting professor at Princeton University. In 2001 Bell-Burnell was named the Dean of Science at the University of Bath.

Professor Bell-Burnell has been one of two Quaker representatives on the British Council of Churches. A life-long Quaker, Professor Bell-Burnell frequently addresses the relationship between science and religion. To this fascinating question she brings the same exacting methods of enquiry as used in her scientific work and adds an enthusiasm that even skeptics find engaging.

Along with her numerous scientific publications, Bell-Burnell presented the Swathmore Lecture at

the 1989 annual meeting of British Quakers, which was later published as a book *Broken for Life*, examining the role of “those with unhealed hurts,” inspired in part by the discovery in 1983 that her son had juvenile diabetes.

In 1998 Bell-Burnell was one of the speakers at the Science and the Spiritual Quest Conference in Berkeley, California, organized by the Center for Theology and the Natural Sciences.

Professor Bell-Burnell says, “Spirituality forms the center of my life and is the driver. As far as I am concerned everything begins and ends here. Astrophysics feeds into my spiritual life only in a minor way. The sense of God that comes to me in still times is so profound that nothing else holds a candle to it.”

References

- “Faith in the Universe: Conversations with Cosmologists.” Gordy Slack. *California Wild* (California Academy of Sciences) - Summer 1998.
< <http://www.calacademy.org/calwild/sum98/skywatch.htm> >
- “Bell Burnell, Jocelyn.” In: Judith Graham, editor. *Current Biography Yearbook 1995*. NY: H. W. Wilson Co., p 42-47.
- “Little Green Men, White Dwarfs or Pulsars?” S. Jocelyn Bell Burnell. *Annals of the New York Academy of Sciences* 302:685-689 (December 1977).
< <http://www.bigear.org/vol11no1/burnell.htm> >

* * * * *