Fig. 1 (Chard). Map of the Bering Strait area showing two routes from Asia to North America.

rate at present suggests that the southern route may have played the most significant role in the initial settlement of the New World (Chard 1959).

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May, 1960

# NATURAL PRESERVATION OF HUMAN BRAIN, WARM MINERAL SPRINGS, FLORIDA

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Abstract

Artifacts of Archaic types, human bones, and a partly burned log have been recovered from three layers of sediments on the floor of a shallow limestone cave now under water. The skeletal remains include a skull from Layer 2 with naturally preserved portions of brain inside. The charred log from Layer 3 produced a radiocarbon date of 5000 B.C. ± 200 years. The age of the preserved brain may not be as great as that of the log and human remains in Layer 3. The radiocarbon date is the earliest known date for man in Florida and suggests that during the early Southeastern Archaic, man lived in limestone caves in Florida when the sea level was considerably lower than at present.

THIS REPORT is based on finds made by Royal while skin diving in Warm Mineral Springs, Sarasota County, Florida. These finds suggest the possibility that during the early Southeastern Archaic, man lived in limestone caves in Florida when the sea level was considerably lower than at present. In Warm Mineral Springs, on the sides of a sloping wall leading into a limestone sink hole, there are ledges and shallow caves containing stalactite, flowstone, and column formations encrusted with travertine. Some of these stalactites are now under water as much as 80 feet. In a section of one cave, where the floor varies from 35 to 40 feet under water, numerous human bones of at least seven individuals (one child, six adults) were found. These included three skulls (one intact with a cephalic index of 74), parts of mandibles, bones of the upper and lower extremities, vertebrae, pelvic bones, and ribs. No pottery has been recovered. Artifacts include two long bone needles, an antler shaft wrench or atlatl weight, a bone pestle, marked deer bones and antlers, and part of a fossil shark's tooth with a chipped edge (Fig. 1). Except for the shark's tooth these few artifacts show similarity with those found at the Eva site in Tennessee (Lewis and Kneberg 1959). Human bones were located several feet under soft sediment, on or near the solid base rock forming the floor of the cave. After numerous dives and examination of this site we were convinced it was occupied at a time of lowered sea level when the cave was dry.

The sediment varies from about 3 to 7 feet in total thickness and is composed of three distinct layers:

1. A top layer averaging 20 to 40 inches in thickness is composed of extremely soft black sediment with numerous tiny shells of *Amnicola augustina* Pilsbry throughout as well as some alligator bones. Travertine deposits occur in loose chunks and coat stalactite fragments and cave walls in this and the following layer.

2. A middle layer varies from 6 to 18 inches in thickness and is more or less dark gray. It is a more compact and hard layer than the top one and is characterized by the presence of the shells of two species of fresh water snails, *Helisoma duryi* Wetherby and *Physa cubensis* Pfeiffer, which are heavily concentrated in the upper por-

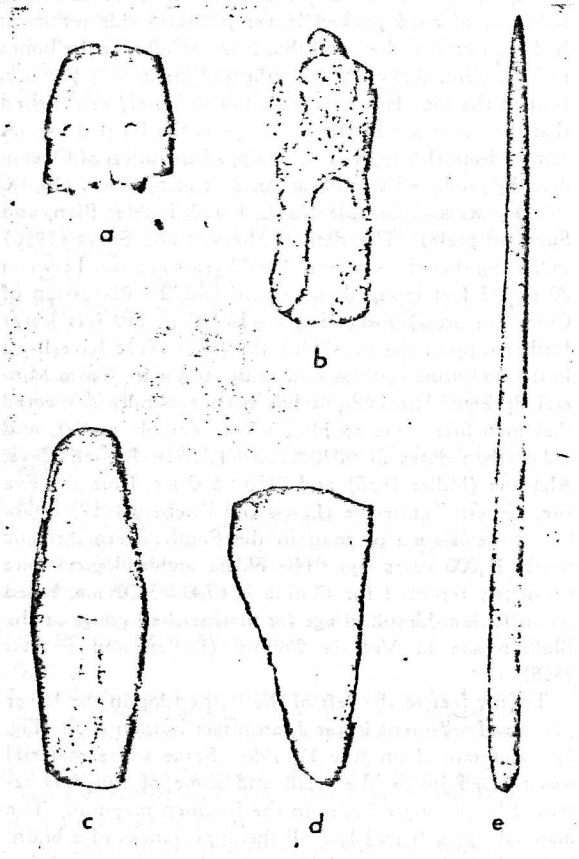



Fig. 1 [Royal and Clark]. Artifacts from Warm Mineral Springs, Florida. *a*, deer bone with cut edge; *b*, bone pestle; *c*, antler shaft wrench; *d*, half a fossil shark's tooth with chipped edge; *e*, bone needle. Length of *e*, approximately 18 cm.

tion of this layer. No *Amnicola* shells have been found here or below. This layer is composed mainly of closely packed leaves of spermatophytes. Bird, deer, and human bones have been recovered as well as pieces of wood, charcoal, and two bone needles. In places, there are clusters of pteridophyte leaves encrusted with travertine, some of which have been identified as probably *Osmunda cinnamomea*.

3. A bottom layer 6 to 20 inches in thickness is sandy in color and also packed with leaves of spermatophytes. Pine cones, hickory nuts, acorns, wood, and charcoal are scattered throughout as well as bones of fresh water turtles, birds, rodents, opossum, raccoon, deer, and man (including the remains of a child). The basal rock on the floor of the cave is a hard limestone with fossil remains of echinoderms, a variety of marine molluscs, and *Carcharodon* teeth. The limestone is in places overlain with hard clay.

During diving trips with Luanna Pettay and William M. Stephens, we examined a partly burned log 3 feet long uncovered from under about 5 feet of sediment. The wood has been identified as Red Mulberry, *Morus rubra* Linnaeus. The position of the log was 38 feet under water and 6 feet back from the outermost stalactites of the overhanging cave roof. One end of the log was imbedded in the hard clay floor and the other end slanted upward at an angle of about 20° and just reached the demarcation between Layers 2 and 3. Human bones were found within a few inches of this log in the lower part of Layer 2 and the bottom of Layer 3. The intact surrounding sediment of hard packed leaves indicates this sediment had been undisturbed and that it is unlikely for the bones to have sunk down through the sediment to a position next to the log. However, it is not definitely established that the bones are of the same age as the burned log. A sample from this log sent to Scripps Institution of Oceanography produced a radiocarbon date of 8000 B.C. (10,000 ±200 years B.P., Sample No. L. J. 120, Hubbs, Bien, and Suess, in press). The data of Shepard and Suess (1956) indicating that the sea level 10,000 years ago was between 80 to 135 feet lower than present and the discussion of Curry (in press) indicating levels 100 to 150 feet lower further support the possibility that man could have lived in the limestone cavities now under water in Warm Mineral Springs. However, it has been generally suspected that man first came to Florida considerably earlier, and radiocarbon dates of 9020±350 B.P. from Russell Cave, Alabama (Miller 1958) and 7150±500 B.P. from the Eva site, western Tennessee (Lewis and Kneberg 1959) establish the existence of man in the Southeastern Archaic nearly 10,000 years ago. The oldest archaeological date previously reported for Florida is 6700±3300 B.P. based on an Ionium-Uranium age for marine shell gouge at the Bluffton site in Volusia County (Bullen and Sackett 1958).

Twenty feet to the left of the burned log in the lower portion of sediment Layer 2, an intact human skull (Fig. 2) was removed on July 11, 1959. Some white material was noticed inside the skull and some of this was removed by putting a finger in the foramen magnum. The material was soft and had all the appearances of a brain. It was brought to our laboratory where the remaining material was viewed through the foramen magnum by a practicing physician and three trained biologists, all of whom thought it looked like fresh brain tissue. The skull and contents were then immersed in formalin. The "brain" seemed to be rapidly disintegrating. It turned from white to dark gray in the next two days and the rounded convolutions became shrunken. Ilias Konstantinu, physician, sawed open the skull in his office in Sarasota. The remaining parts of the "brain" which had come apart were removed and the sediment washed off.

These fragments were examined by a number of medical doctors of the Sarasota Memorial Hospital staff who

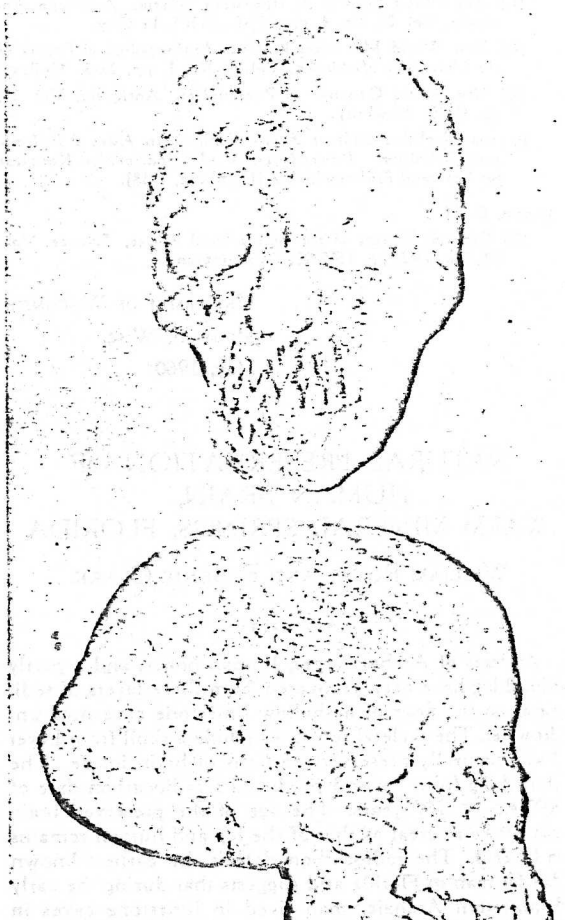
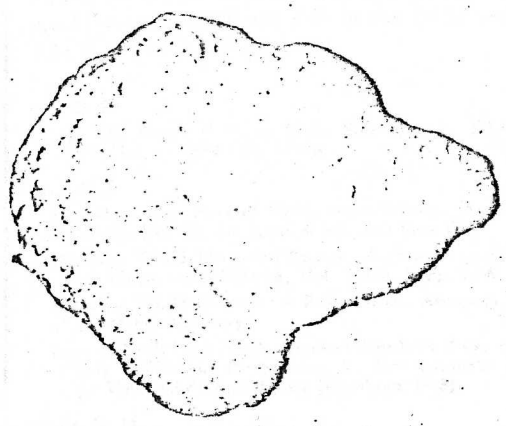


Fig. 2 [Royal and Clark]. Human skull with preserved brain from Warm Mineral Springs, Florida.



3 [Royal and Clark]. Fragment of the cerebrum of soft brain found inside the skull in Figure 2. Length, about 4.8 cm.

gested that the material had the form of a brain. Benjamin H. Sullivan, neuro-surgeon, stated that one piece appeared to be cerebellum and the other large pieces were obviously from the cerebrum (Fig. 3). From gross examination of a section through a cerebral fragment it was easy to differentiate the outer gray matter of fairly homogenous structure from the white matter which was fibrous in appearance. All the large recognizable fragments appeared to be mainly cortex. John S. Bracken, histologist, made microscopic examinations of a stained histologic preparation but could find no cellular structure. Biochemist, Isadore Chamelin, ran a quantitative determination of a sample taken from the white matter of the cerebrum. The dried material weighing 11.7 mg. gave positive Salkowski and Lieberman-Burchard reactions. Quantitative determination of the substances present reacting with the Lieberman-Burchard reagent produced a value of 2 milligrams, equivalent to 17.08% cholesterol, sterols and phytosterols, with an analytical error of ±5%. Alan P. Oakley, British Museum (Natural History), after examining a Kodachrome transparency and sample of the brain itself, wrote us that "one is left without any doubt whatever that the fragments in question are pieces of human brain." Oakley submitted the sample we sent him to G. C. Ross, in the laboratory of the Zoology Department, who reported the ashed weight of the original sample as 42.3% suggesting some mineral impregnation. Instances of the preservation of the human brain for periods up to several millennia have been reported in the case of Peruvian (Rivero 1857) and Egyptian (Smith 1902, 1911) mummies and cadavers recovered from peat bogs (Spatz, Kenk, and Diezel 1957). Thouret (in Spatz, Kenk and Diezel 1957: 130) found brain tissue preserved in cadavers exhumed from a cemetery when the rest of the soft tissues were disintegrated. Oakley (1960) has reported a brain of Roman age preserved in adipocere. The brain from Warm Mineral Springs, however, appears to be the first instance known where preservation is believed to have taken place in water even though initially the brain may have been in a dry or damp environment. The preservation conceivably could have occurred due to some antibiotic activity of the sediment or spring water similar to the case described by Breder (1957) where the soft parts of a fish failed to decompose in aquarium water containing a population of *Pseudomonas eisenbergii* Migula.

The age of the brain may not be as great as that of the burned log and the human remains in Layer 3 on the cave floor because it was recovered from Layer 2.

*Acknowledgments.* We are grateful for the help and cooperation of the persons already mentioned and also the following: Al McFadyen of Warm Mineral Springs, Inc., encouraged this study and gave us permission to dive in the springs; Harold K. Brooks, geologist, University of Florida, confirmed the stalactite formations; William J. Clench, Museum of Comparative Zoology, Harvard University identified the molluscan shells; Carl L. Hubbs and H. E. Suess, Scripps Institute of Oceanography, arranged the radiocarbon dating of the burned log; B. Francis Kukachka of the U.S. Forest Service, identified the wood; Erdman West, botanist, University of Florida, identified the fern; Kenneth P. Oakley, British Museum (Natural History), Tilly Edinger, Museum of Comparative Zoology, Harvard University, and Harry L. Shapiro, American Museum of Natural History, gave helpful comments on this manuscript.

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