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FIELD RESEARCH REPORT

Proof Positive—Loch Ness Was an Ancient Arm of the Sea

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Abstract—For the first time, indisputable marine deposits have been recovered from Loch Ness. Recovered clam shells have been reproducibly dated by the radio-carbon (^{14}C) method to about 12,800 years before present (BP), which corresponds to the end of the last glaciation. Hitherto, this oceanic incursion has been doubted or denied by many observers. Such a period of marine incursion is crucially demanded by the hypothesis that the Loch Ness "monsters" are or were a reproducing population of creatures too large to move in and out of the loch under current conditions. Even more remarkably, aminoacid racemization indicates an age of about 125,000 years for some of the deposits, corresponding to the *previous* interglacial period. If the latter dating withstands further investigation, current beliefs about the chronology of glaciation and land-and-sea-level changes at and around Loch Ness will have to be modified.

Keywords: Loch Ness (marine incursions)—Ice Ages (Scotland)

Introduction

This report addresses the latest findings of the Academy of Applied Science (AAS) Loch Ness research team (www.aas-world.org), supplementary to the results of previous forays. Particularly in the early and mid-1970s, sonar and underwater photographic evidence was adduced of large, possibly once-marine animals in the loch (Rines & Scott, 1975; Rines et al., 1976; Ellis, 1977; NOVA, 1998; CBS, 2001). This evidence has been recently reviewed and analyzed by Bauer (2002).

As Bauer recounts, there have been disbelievers and skeptics and even some who just dismiss the possible validity of this evidence out-of-hand, and, in particular, that school which doubts the entry of the ancient sea into the Great Glen Fault or Rift that might, indeed, have enabled large sea animals to enter the rift now occupied by the totally fresh water of Loch Ness, whose surface is some fifty feet above current sea level.

According to established geological theories as to the formation and glaciations of Scotland and England, the periods of their glacial overrun during Europe's Great Ice Age more than a hundred thousand years ago were followed by a long interglacial period until the most recent glacial period, which is generally believed to have ameliorated about ten to fifteen thousand years ago

(Kirk & Godwin, 1963; Ruddiman & McIntyre, 1973; Sissons, 1974; Peacock et al., 1980; Sutherland, 1986; Overpeck, et al., 1989; Bauer, 2002). Some of these theories entail the total absence of the sea from the Great Glen Rift.

Startlingly, in August of 2001, and fortuitously again in June of 2002, the AAS team found and unequivocally verified the presence of ancient sea beds, ancient marine clam shells, and colonies of former ancient sea life buried under the silty bottom in about 325 feet of fresh water in Urquhart Bay, midway between Inverness in the north and Fort Augustus at the south end of Loch Ness.

Proof Positive—The Sea Was in the Great Glen Fault

Loch Ness has now electrifyingly revealed the secret of its ancient, though perhaps periodic connection to the sea, and at long last has given up physical remnants of the smaller sea animals and sea life that once occupied that portion of the Great Glen Rift and that we have now positively dated by both radiocarbon (^{14}C) and aminoacid reaction-rate procedures.

It was the serendipitous recovery of such remnants while the AAS team was pursuing its July-August, 2001, underwater search for further evidence of large animals earlier reported in the loch, that provided the breakthrough about which this paper reports.

We were then exploring the mouth of Urquhart Bay with our underwater video camera sled, a ‘‘remotely operated vehicle’’ (ROV) (Figure 1) controlled by a seven-hundred-foot tether cable from our fishing-vessel tender, the *Boy David.* A strong southwest wind rather suddenly came up and started a serious dragging of the tender’s Danforth anchor that signaled to us that it was time to terminate our experiment and recover the ROV. While it was not a great problem to bring in the ROV despite the wind and waves, and to secure it to our stern, the anchor, on the other hand, had become lodged from its wind-driven deep dragging in the ridges of the somewhat rocky bottom. For some time, it stubbornly resisted disengaging, even under powerful electric winching and the expert seamanship of Ken and David Skea, our crew. Luckily, however, the hinged blades of the anchor suddenly released their hold on the deep sub-bottom and the anchor was retrieved and it rested on the gunnel of the vessel.

Frank ‘‘Doc’’ Dougherty, our recently departed beloved geological expert from Inverness, and Ken Skea were among the first to notice a much darker collection of bottom ‘‘mud’’ or ‘‘clay’’ stuck on one of the anchor blades than we had ever seen on many earlier bottom dredgings and video inspections of the loch. In the mud were buried two 3-cm clamshells—certainly not indigenous to what freshwater Loch Ness had earlier yielded—and other broken shell and fragmentary ocean bottom matrix material as well (Figure 2). While the usual procedure was to throw a bucket of water over the anchor to clean off the debris, we fortunately had the presence of mind carefully to recover and retain these materials, and we now address the secret that they ultimately revealed.

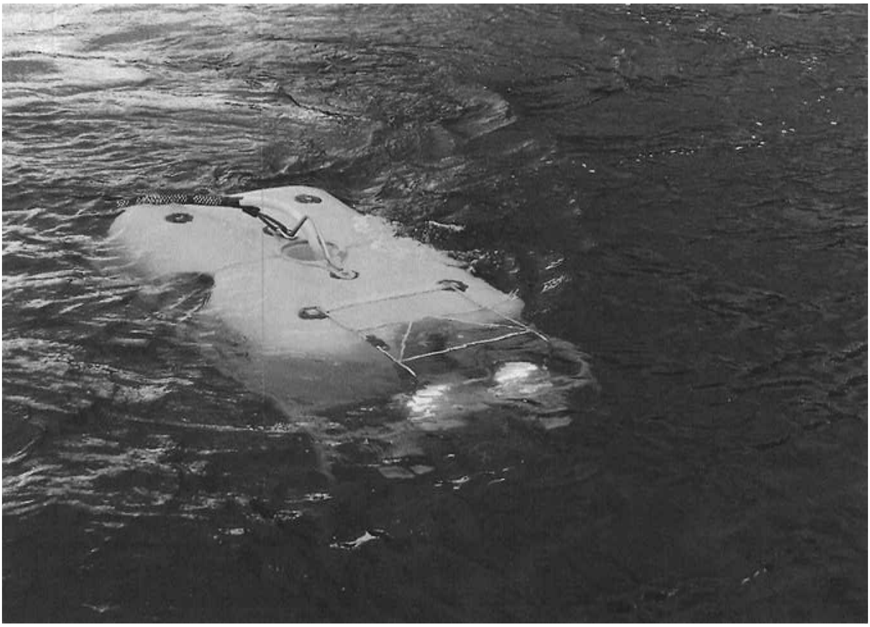

Fig. 1. The ''remotely operated vehicle'' (ROV), which was controlled from an anchored tender, at the surface; tether cable visible from mid-ROV and stretching to upper left, lights visible at lower right.

The obviously de-calcined and old state of the clamshells raised the immediate suspicion—even in those of us acquainted with, though not expert in, marine life—that we were dealing with ancient sea deposits, and probably not just kitchen wastes dumped into the loch by early castle dwellers in mediaeval times who may have discarded sea clams obtained from the coast, or even earlier ''middens,'' or from passing boats in recent centuries. Despite being de-calcined and old in appearance, the two complete shells—which incidentally were not a matching pair—once cleaned, turned out to be in exceptional condition (Figure 3).

Careful scientific analysis carried out by our colleagues, naturalist Adrian Shine and marine biologist David Martin of the Drumnadrochit Loch Ness Research Project, who enlisted the further expertise of Professor Ian Boomer of Newcastle University, yielded positive identification of these clam shells as sea ''blunt gapers'' (*Mya Truncata*), and identification of the material in the matrix clay deposit as totally of marine origin, containing, specifically, fragments of echinoid (sea-urchin) spines, foraminifera (*Elphidium earlandi*, *Elphiduim excavatum* [*sensulate*], and *Lamarckina haliotided*), ostracods (*Semicytherura nigrescens*, *Hirschmannis viridis*, *Cythere lutea*, and *Sarsi-cytheridea bradii*), and other sea mollusk bits (Shine et al., 2001).

Were old marine deposits buried in the bottom of this part of Loch Ness? Definitely yes, but how old?

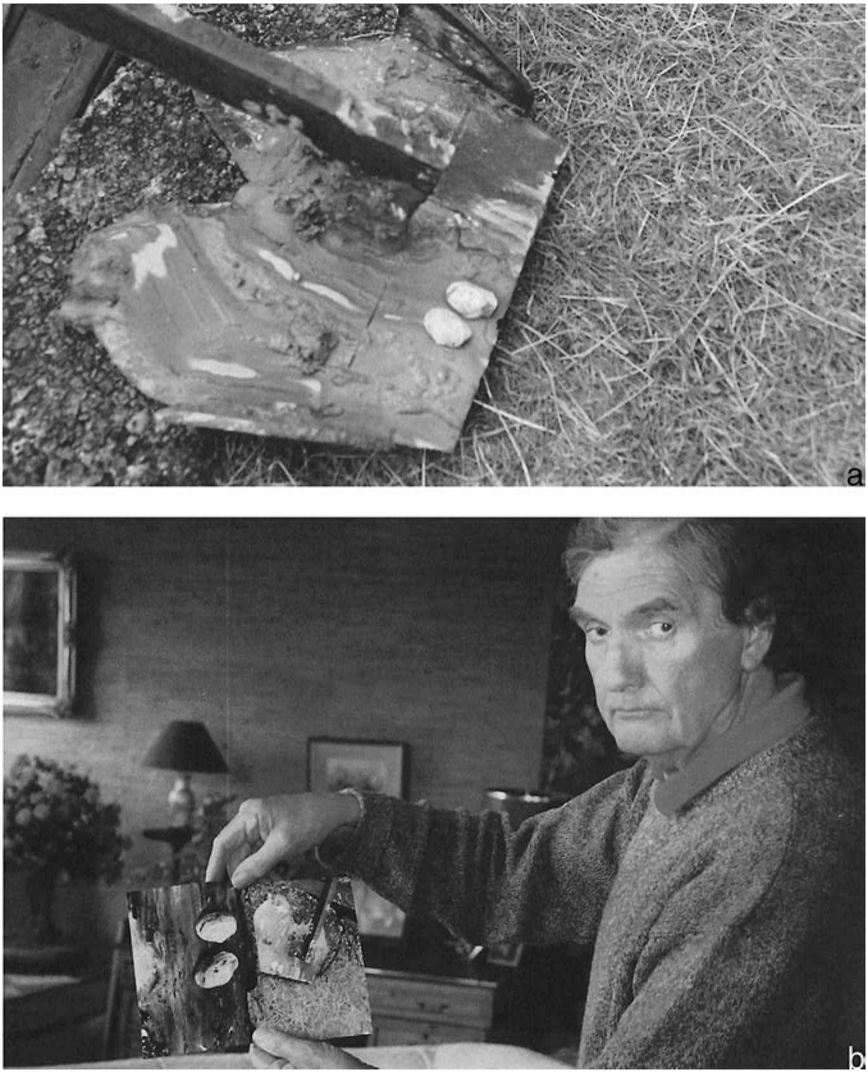

Fig. 2. (a) The anchor with relatively small sample of clay matrix and already washed clam shells. (b) Frank Dougherty with photos of recovered marine deposits and clam shells.

Our Academy enlisted the assistance of three sets of world-class ^{14}C and amino-acid-ratio marine-biology dating institutions and experts to answer this question. First, they all unanimously verified the *total* marine-origin character of our materials.[1]

Geochron Laboratories of Cambridge, Massachusetts, using the Livermore Laboratories Van der Graff high-energy accelerator, provided ^{14}C dating technology; similarly and independently, Woods Hole Oceanographic Institution,

Fig. 3. The cleaned clam shells, two bi-valve halves.

Massachusetts, through Dr. Ann Nichols and Kathryn Elder, applied their ^{14}C electron-beam-accelerator dating technology; and Newcastle University, through Dr. Ian Boomer, dated deposits by the aminoacid reaction-rate or ratio measurements (Miller & Brigham-Grette, 1989).

Before announcing the results, it is significant to report that others have earlier determined by various approaches the date of the last or most-recent glacial retreat and ice-free condition of the environs of the Great Glen Rift. One such study by ^{14}C dating of nearby lake-floor sediments yielded an age of 12,810 BP $\pm$ 155 years (Kirk & Godwin, 1963). Another, by measuring Atlantic warming and the return of normal air temperatures as polar water withdrew from Scotland, gave a date of 13,000 BP (Ruddiman & McIntyre, 1973). Yet another, by ^{14}C dating of marine shells from the Clyde Estuary, determined that deglaciation had been completed by 12,600 BP (Sutherland, 1986).

Clamshell fragments broken off one of the 3 cm clams and from other shell bits in the bottom material matrix that we recovered in Loch Ness, were, as before mentioned, submitted for ^{14}C dating. This yielded indistinguishably the very same dates as the end of the last glaciation: 12,840 $\pm$ 50 years BP[1] (^{13}C; Geochron, 2002) and 12,800 $\pm$ 55 years (Nichols & Elder, 2002).

The sea was thus in the Great Glen Rift for centuries after the last glacier had receded and before the loch became land-locked by the relative change of land and sea levels. This fact must now be considered to modify earlier theories of the geological formation of Scotland and the effects of the last glacier in the Great Glen Rift—not to speak of the Academy's particular interest in the centuries of exchange of sea animals with the basin now known as Loch Ness.

In June of 2002, we returned to the loch and repeated our experiments—fortuitously re-locating this former seabed under Loch Ness and again recovering further samples of precisely the same type of ancient shells and sea-bottom matrix.

Yet this is not the full story.

As a setting for the reporting of our additional findings, we first call attention to the earlier-mentioned evidence of others that the previous Great Ice Age of Europe had receded over a hundred thousand years ago and left a long interglacial period until the development of the most recent glacier. This may be highly significant to our further disclosure that, by aminoacid reaction-rate dating, Boomer et al. (2002) have reported,[2] and verified under different temperature hypotheses, that the ancient sea-bed-matrix material we recovered appears, indeed, also to be coincidentally in the range of about 125,000 years old!

In trying to reconcile the order-of-magnitude difference in this dating from the ^{14}C dating, we observe that while the aminoacid results are known to be beyond the range of ^{14}C dating, is it conceivable that the younger dating could result from some phenomenon such as the re-precipitation of shell carbonates?

Or could it perhaps, and more probably, be that some of the ancient sea bed we stumbled upon actually was formed by the ocean entering the rift after the melting of the Great Ice Age of Europe 125,000 years ago? And again, after the interglacial period and the forming and then the melting of the last glacier about 12,800 years ago, did the sea once more enter for thousands of years until Loch Ness became land-locked? And might there be ocean and shell deposits from *both* incursions of the sea, tens of thousands of years apart, in our recovery?

In such an event, for over a hundred thousand years or more (over a thousand centuries), whatever animal life was in the sea, both between and after successive glaciations, could have freely entered and left and lived in the Great Glen Rift in the very volume now occupied by pure fresh-water Loch Ness.

Our presently incomplete but continuing studies and analysis in the area off the Urquhart Castle peninsula, which overlooks the ancient-sea-bed site of our discovery, and which somehow miraculously was protected from the glacial erosion and destruction suffered by the rest of the Loch Ness region (several experts agree it should not still be there), appears to have some other surprises in store on which, upon further verification, we hope to report in the near future.

Notes

† Deceased

[1] "Loch Ness clams—Age 12840 ± 50 ^{14}C years BP (^{13}C corrected) .... The age is referenced to the year A.D. 1950" (1950 is defined by convention as "O BP")—Geochron (2002).

[2] "Our kinetic analysis would suggest that a late Devensian age for shells in this region is too young . . . the DMK values would still put the shells beyond the limit of radio carbon"—Boomer et al. (2002) on amino-acid-ratio measurements of the matrix materials.

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