Sonar and Photographic Searches for the Loch Ness Monster: A Reassessment

Seven weeks of continuous sonar monitoring found no sign of any large creature. Re-evaluation of sonar and photographic methods used by previous expeditions found them inadequate. Some blatant discrepancies were discovered, especially in the famous "flipper" photographs.

Rikki Razdan and Alan Kielar

THE EXISTENCE of a Loch Ness monster has long been the subject of speculation. In recent years, mainly as a result of sonar work carried out by Robert Rines and co-workers [1-4], the phenomenon has gained sufficient scientific credibility that a zoological classification has been ascribed to the creature [5].

Alleged scientific evidence for the existence of a Loch Ness monster dates back to as early as 1960. Copious amounts of data have been generated through expeditions conducted by Cambridge [6] and Birmingham [7] universities, the Loch Ness Investigation Bureau [8], the Loch Ness and Morar Project [9], and the Academy of Applied Science [1-4].

A thorough evaluation of this data led us to question its validity. In many instances, the findings were distorted by significant procedural and quantitative errors. We present evidence here on a case-by-case basis that conflicts with the findings of these researchers and renders inconclusive claims for the existence of the Loch Ness monster.

The questionable accuracy of this previous data coupled with our

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longstanding interest in the Loch Ness legend prompted us to initiate our own expedition to Loch Ness in May 1983. We designed a tracking sonar array specifically for this purpose at our laboratory in Rochester, New York. This expedition had the advantage of being able to image in three dimensions and obtain an actual tissue sample from any large underwater creature coming within range of our 25-meter × 25-meter array. The karyotype analysis of a tissue sample would provide conclusive evidence of the existence of some unique creature, in contrast to ambiguous sonar traces and photographs presented by previous researchers.

The 15-ton sonar apparatus, which can scan a depth of 33 meters, was tested during the summer of 1982 at Conesus Lake in New York State and was then shipped to Temple Pier, Drumnadrochit on Urquhart Bay at Loch Ness. The array consisted of 144 sonar transducers, arranged in a 12 × 12 grid. It imaged the area under which it floated by measuring the water depth directly beneath the individual sonar transducers. These depths were displayed on a television monitor as color-coded blocks arranged in a 12 × 12 grid pattern corresponding to the placement of the transducers. Any sonar target over 3 meters in length moving under the grid triggered an alarm, and the target was automatically tracked in three dimensions. Schools of fish were automatically recognized and ignored by the tracking electronics based on an analysis of the return echoes from each sonar transducer. Nine underwater dart guns with retrievable biopsy tips were mounted on the array and could be automatically fired upon detection of an intruder beneath. If a tissue sample were obtained from a large target, arrangements had been made for its analysis at the Zoology Department of Glasgow University. The sonar transducers [10] were encased in rubber flotation collars and were separated from one another by 2-meter-long aluminum cross-pieces.

The array, tethered to shore by a 330-meter control cable and floating in approximately 65 meters of water, was moored adjacent to the raft used by the Academy of Applied Science (AAS) expedition in 1976 [11]. The array was powered by 12 volts of direct current (DC) to avoid the possibility that alternating current (AC) might frighten away marine life. All sonar information was automatically recorded on videotape. The equipment, except for the biopsy darts, was tested with a scuba diver and air-filled calibration targets and functioned as designed. The biopsy darts were capable of reaching a depth of 33 meters. By July 25, 1983, the array was fully functional and ran continuously until September 16, 1983. During that time it recorded nothing larger than a 1-meter fish. We are aware that our stationary array could monitor only a very small area of the Loch, but this area was one that had produced the most compelling evidence to date [1-4].

Our working on the project beside the loch for four and a half months established our credibility with the local residents. They were



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Kielar and Razdan at Loch Ness with their sonar array.

familiar with previous investigators and their work, particularly that of the AAS. The AAS's investigations had been the most ambitious and their results the most dramatic. Our conversations with these residents uncovered background material that contrasted with the published circumstances under which the Academy's results, especially the well-known flipper photographs [1], were obtained. We continued to review previously published sonar work carried out at Loch Ness and investigated its original sources at the Inverness Library and the Loch Ness Centre in Drumnadrochit. Our findings place much of this seemingly credible data into a more proper perspective.

Sonar Searches at Loch Ness

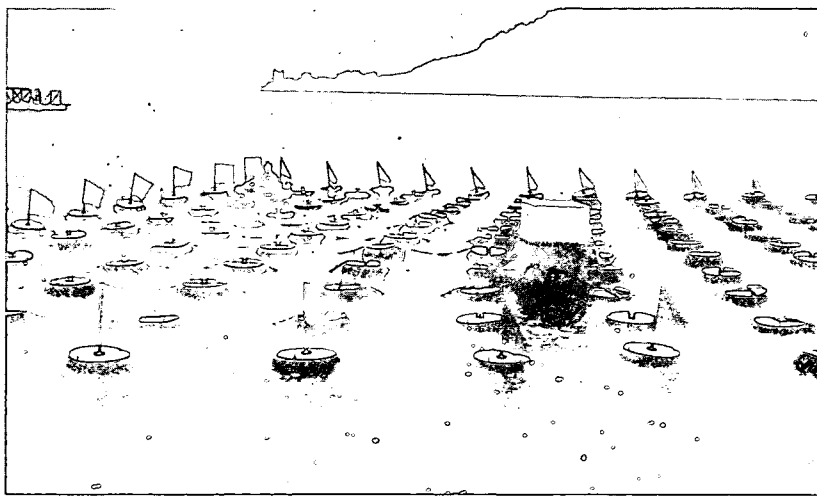
The first organized sonar searches of Loch Ness, using echo sounding and dredging equipment, were conducted by Cambridge and Birmingham universities between 1960 and 1962. Several authors [12] have reported that this investigation produced evidence of a Loch Ness monster. However, the actual reports [6, 7] indicate a general scarcity of animal life in the loch and state that no unexplained objects were encountered in either the echo sounding or the dredging operations.

In 1968 Braithwaite and Tucker [13], from the University of Birming-

ham, deployed an experimental digital sonar system off Temple Pier. The system ran continuously for a two-week period and produced a 13-minute sequence showing targets rising vertically underwater, with velocities exceeding those of known fish. We found that Tucker, after continued on-site experimentation through 1970, attributed those earlier sonar contacts to gas bubbles and thermal effects encountered over the long range (1.2 kilometers) of their sonar beam [14].

In 1969, under the auspices of the Loch Ness Investigation Bureau (LNIB), Robert Love conducted extensive channel-wall and bottom-echo soundings in the loch [8]. These narrow-beam soundings gave no indication of underwater caverns or overhanging ledges in the loch walls. His transverse sonar running across the loch denoted a general wall slope of 45 degrees, leading to a fairly uniform bottom depth of 200 to 230 meters. Love also conducted midwater patrols with a sector-scanning sonar, making only one documented contact with a large and seemingly inanimate object. Although he admitted that the target's vertical movement could not be assessed, he claimed that the target exhibited horizontal movement of an unusual, hence animate, nature. However, our analysis of his published data [15] revealed that inconsistencies in the correlation of his boat's speed with the distance he covered during the fixed observation time of the phenomenon, coupled with ambiguous ship's head information, suggest he may have been tracking a fixed underwater target, possibly debris from past expeditions [16]. In addition, the 15-degree width of Love's sonar beam at the target's maximum range of 480 meters is a significant proportion of the target's calculated horizontal movement.

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duced into the loch. It has been credited with obtaining a depth reading of 320 meters off Urquhart Castle. We discovered that this reading was actually made with a depth sounder from a boat on the surface [17], presumably over the submarine. The area of the loch in question has been crisscrossed many times since 1969, and no depths greater than 250 meters have been reported [9].

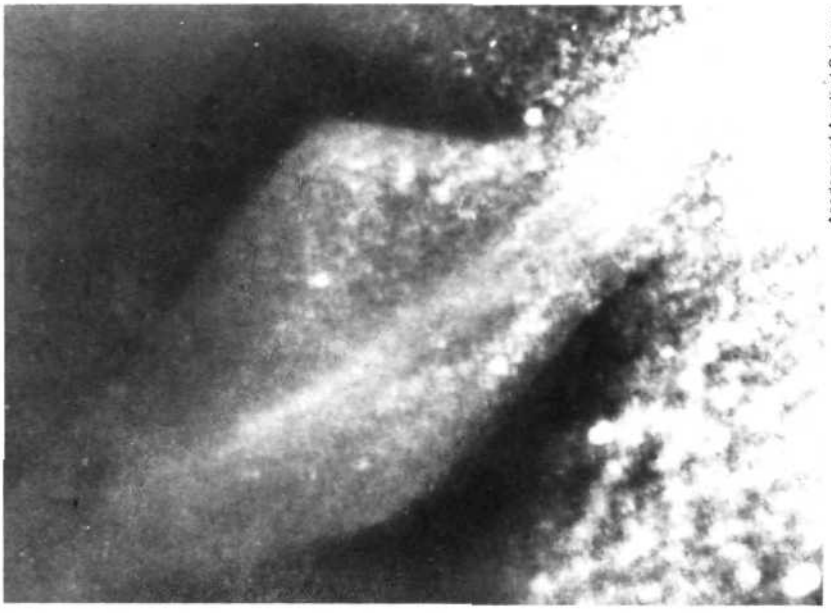
The most recent sonar data to come from Loch Ness are contacts made by Shine during the summer of 1982 [9]. Although the sonar traces show apparently strong midwater targets, none of Shine's contacts conclusively demonstrate any horizontal or vertical movement. As with Love, we deduce that he probably obtained sonar echoes from stationary midwater debris.

The AAS Investigation and the Flipper Photographs

The most ambitious investigation of Loch Ness was undertaken over a period of eight years, beginning in 1970, by the Academy of Applied Science, Belmont, Massachusetts, headed by Rines. In 1970 the results of a three-day side-scan sonar test by his colleague Klein indicated that there were large moving objects in the loch and that there are large ridges or caves in the steep walls of the loch and that could conceivably harbor large creatures [18]. These findings, published in 1976 [2], were regarded as important discoveries. Our study of a 1972 Academy publication revealed that Klein had interpreted the 1970 large moving sonar targets as "probably from three large fish" [19] and emphasized the necessity of probing the areas that appeared to be caves or overhangs with "a narrow conical beam sonar, to look straight in at the walls to determine the actual depth of these undercuts" [18].

In 1971 the Academy conducted "copious sonar profiles" [20] of Urquhart Bay. These profiles indicated the presence of significant underwater mounds and channels, and Rines spent considerable time correlating eyewitness surface sightings of the monster with these unusual topographical features [21]. He speculated that "it is along these deep ravines, in parts several hundred feet deep, that large creatures could frolic . . . without ever rippling the surface" [22]. In fact, we found that no sonar studies conducted prior to, or after, the Academy's survey show anything but a fairly steep slope down to a flat bottom [8, 9].

A paper entitled "Sonar Eyes Unmask Urquhart Bay" [4] contains the following statement by Rines: "In the summer of 1971, the Academy of Applied Science (AAS) team, in the company of local residents (former RAF wing commander Basil Carey and his wife Winifred), viewed and tried to photograph in the dusk, over a five minute interval, 20 feet of slowly moving black hump protruding at least five feet out of the calm waters of Urquhart Bay before submerging" [23]. On August 4, 1983,



Academy of Applied Science

The famous flipper photo, supposedly enhanced by a computer at the Jet Propulsion Laboratory.



Academy of Applied Science

The actual JPL computer-enhanced photo.

along with Ivor Newby and Dennis Vann [24], we talked to Mrs. Carey [25] about that evening in 1971. Mrs. Carey demonstrated for us how, on the evening of June 23, 1971, with Rines present, she dowsed [26] for the monster using a dowsing stick, a map, a pendulum, and a nonmagnetic pencil. She claimed that the point on the surface of the loch where Rines reported sighting the monster was the very one she had predicted to him, and she gave us a map on which she had recorded her 16 monster sightings since 1917, including the one made that evening with the AAS team—composed of only "Bob and Carol Rines" [27]. Asked if she could describe her impressions of the sighting that summer night in 1971, she said: "It was a dark evening. It could have been anything."

Also in 1971, Rines described the mysterious disappearance of a camera-strobe unit being used for underwater photography in Urquhart Bay [28]. A photograph of a loop of rope [29], taken while the camera was presumably being towed about the loch by the monster, was captioned a "rope loop" or "flipper." Rines interpreted a large, bodylike shape into the picture, even though we were told by local residents [30] that a fisherman had caught his propeller in the camera's buoy marker and that the camera had drifted out of the bay into the midwater and was later recovered by a passing LNIB member.

In 1972, Rines produced the dramatic photographs purporting to show the flipper of the Loch Ness monster, taken in Urquhart Bay off Temple Pier with a linked camera-strobe sonar system. According to an illustration published by the AAS [31], a sonar transducer was mounted on the sloping loch-bottom in about 10 meters of water overlooking the camera-strobe unit, which was also secured to the bottom in about 15 meters of water. Photographs taken by the camera-strobe unit could be confirmed by the presence of objects detected within the sonar's beam, and the linked system could provide a rough dimensional analysis of those objects. According to the Academy, on the morning of August 9, 1972, Rines and his crew (personnel from the AAS and the LNIB) waited aboard two boats in Urquhart Bay. One boat monitored the sonar equipment, the other the camera-strobe unit. At around 1:00 A.M. on August 9, the investigators detected what appeared to be large objects moving into the transducer's beam. Underwater photographs were taken and, when developed in the United States, showed only faint shapes [32]. After image enhancement by Alan Gillespie at the California Institute of Technology's Jet Propulsion Laboratory, the flipper photographs, and the photograph apparently showing two large bodies were published in books and magazines throughout the world [33].

Further discussion about the events of August 9 with Mrs. Carey uncovered previously unpublished information crucial to the integrity of Rines's findings. This information was later corroborated by Holly Arnold [34], an active participant in the events of August 9, 1972. Mrs. Carey

recounted to us how, through the night of August 8 and the early morning of August 9, she dowsed for the monster from her house overlooking Urquhart Bay, while Rines remained with the boats on the water. At about 1:00 A.M. she "detected" two monsters in the vicinity of the river's mouth in the bay. Mrs. Carey then alerted Rines to the monsters' location by a prearranged signaling system, involving the flashing of automobile headlamps in a code corresponding to numbered blocks superimposed over a map of Urquhart Bay. Rines and the crews then proceeded to lower overboard the camera-strobe unit from one boat and the sonar transducer from the other.

The sonar traces [35] from the August 9, 1972, encounter indicate that the transducer unit was not secured to the Loch's bottom, as shown in the illustrations in most books and publications, but was free-swinging [36]. Nowhere in these sonar traces can the camera-strobe unit or its umbilical cable be seen as they would have been if the published illustrations had been accurate. With the camera and sonar units deployed in this manner, it would have been impossible for Rines to make any rational correlation between any underwater photographs and the sonar traces. Also, during the sonar contact of August 9, 1972, several investigators were rowing a large wooden fishing boat between the boat tending the sonar equipment and the boat tending the strobe cameras [37]. This could account for the sonar traces attributed to two monsters. In our opinion, the sidelobe echoes from the "flipper" sonar traces show that the transducer was moving about underwater, and the main beam traces have the obvious characteristics of boat wakes.

Apart from the circumstances in which they were obtained, the flipper photographs themselves do not stand up to scrutiny. On returning to the United States in October 1983, we contacted Alan Gillespie at the Jet Propulsion Laboratory and established that Rines had provided him with copies of his 1972 flipper photographs for image enhancement. The computer-enhanced versions were returned to Rines and were subsequently published in *Technology Review* [1]. We have copies of the two original flipper photographs before enhancement [38], the enhanced versions, and finally the published versions. Alan Gillespie sent us copies of the enhanced flipper photographs he returned to Rines, and we discovered that, prior to publication, areas of these enhanced photographs had been significantly altered to give the impression of the flipperlike objects that appear in the published versions. We feel this discrepancy is very important because it was these flipper photographs that led Sir Peter Scott to assign a zoological classification to the creature, *Nessiteras Rhombopteryx* (Ness Beast with the Diamond Shaped Fin) [5].

In 1975 Rines obtained "close up color photographs of the head, neck and body of one of the animals" [39]. They were published in 1976 [1]. The deployment of the camera-strobe unit when these pictures were taken

again deserves comment. Tim Dinsdale describes how the unit was "trailed from the stern of Hunter [Rines's boat] on the end of some 30 feet of rope and allowed to swing around with the boat, as wind and chance determined" [40]. Dick Raynor, a former member of the LNIB, who was present during this expedition, recalled that the camera-strobe unit taking the pictures was retrieved from the bottom of the loch with ten feet of slack on its buoy rope because the boat had swung into shore [41]. Given these circumstances, the published photographs can be most reasonably interpreted as debris on the loch bottom or side walls. Rines claimed to have sonar traces showing the intrusion of large objects into the zone of camera coverage, but these have not been published. On the basis of Rines's 1972 and 1975 evidence, *Nature* published "Naming the Loch Ness Monster" [5], seemingly legitimizing what the facts suggest is unscientific and careless research.*

The Academy of Applied Science returned to the loch in 1976 with the financial support of the *New York Times.* Professor Harold Edgerton (a pioneer in strobe photography) accompanied this expedition. Underwater television cameras and camera-strobe units were suspended from boats and finally attached to a raft moored off Temple Pier. Once again the equipment was not rigidly fixed underwater [11]. At one point during the summer a large sonar trace was obtained that had, said Rines, "the same dimensional extent in 1972 . . . the same type of multiple trace echo and the same type of approach to the camera from behind as in 1975" [42], but *this trace was immediately established to have been caused by the wake of a boat* [43].

A paper by Harold Edgerton in 1978 [3] outlined sonar data gathered during the summer of 1976 at Loch Ness that, while not concluding that a monster exists, suggested that further research was warranted. In this paper, he equated the width of observed sonar targets with the actual trace thickness produced on a sonar chart recorder. However, it should be recognized that there is not necessarily a linear correspondence between a target's sonar track thickness and the true thickness of an object intruding into a sonar beam. No calibration sonar traces were included in his paper for comparison.

Klein, conducting additional side-scan sonar testing in 1976, attached archaeological significance to his discovery of numerous stone circle formations, groups of which he named Kleinhenge I and Kleinhenge II, on the bed of Loch Ness [44]. Our research at the Inverness Museum (summer 1983) quickly discounted his theories, since, during the construction of the

**Note added by editor:* In December 1975, *Science News,* the magazine I then edited, contacted David Davies, the then-editor of *Nature,* for elaboration. He emphasized that Rines's article and photos had been published in *Nature*'s "Comment and Opinion" section, which meant they had not undergone any peer review process. He said *Nature* did not vouch for the validity of the claims (*Science News,* 108:391, Dec. 20/27, 1975).—*K.F.*

Caledonian Canal in the early 1800s, dredge steamers routinely dumped such piles of stones into Loch Ness. Formations similar to those that Klein discovered can also be found near the mouth of the canal in Loch Oich and Loch Lochy.

Conclusion

We have shown that continuous sonar monitoring for seven weeks to a depth of 33 meters in an area where many previous sonar contacts had been reported showed no evidence of anything larger than a 1-meter fish. The circumstances under which previous expeditions had obtained sonar and photographic evidence in support of the existence of the Loch Ness monster could not withstand scrutiny. The evidence itself revealed discrepancies. This is especially true of the Academy's flipper photographs, the published versions of which differ from the original computer-enhanced photographs. Careless deployment of equipment and overzealous interpretation of the data account for much of the so-called scientific evidence.

While it is not possible to prove definitely that a monster does not exist, the evidence so far advanced strongly suggests that the Loch Ness monster is nothing more than a longlived and extremely entertaining legend.

Notes and References

1. R. H. Rines, H. E. Edgerton, C. W. Wyckoff, and M. Klein, *Technology Review*, 78, no. 5 (1976):25.

2. M. Klein and C. Finkelstein, *Technology Review*, 79, no. 2, (1976):3.

3. H. E. Edgerton and C. W. Wyckoff, *IEEE Spectrum*, 15, no. 2, (1978):26.

4. M. Klein, R. H. Rines, T. Dinsdale, and L. S. Foster in *Monograph 1 Academy of Applied Science*, Academy of Applied Science, 1972.

5. *Nature* 258 (1975):466.

6. Report of the *Cambridge Loch Ness Expedition*, 1962.

7. Preliminary report of the *Birmingham University Loch Ness Expedition*, 1961.

8. D. James et al., *Annual Report of the Loch Ness Investigation Bureau*, 1969.

9. A. Shine, *New Scientist*, 97, no. 1345 (1983):462.

10. Radarsonics Model 231, 200 KHz with 8.5° beam width at -3db.

11. M. Klein and C. Finkelstein, op. cit., p. 9.

12. A. Shine, op. cit., p. 466; N. Witchell, *The Loch Ness Story* (Baltimore: Penguin, 1975), p. 104; T. Dinsdale, *The Story of the Loch Ness Monster* (London: W. H. Allen and Co., 1982), p. 105.

13. H. Braithwaite and D. G. Tucker, *New Scientist*, 40, no. 628 (1968):664.

14. D. G. Tucker and D. J. Creasey, *Proceedings of the Challenger Society,* 4 (1970):91.

15. D. James et al., op. cit., p. 16.

16. Our conversations during the summer of 1983 with Ivor Newby, a participant in many expeditions at Loch Ness since the sixties, revealed that monster hunters have either lost or failed to retrieve numerous bits and pieces of their underwater gear over the years. He told us that several plexiglass-enclosed cameras are still presumed floating in the midwater, moored to the lochbed, as are at least two steel gas-cylinders used for sonar calibration tests in the 1960s. This type of debris would give strong sonar returns.

17. Ivor Newby and Adrian Shine, private communication.

18. M. Klein, R. H. Rines, T. Dinsdale, and L. S. Foster, op. cit., p. 39.

19. Ibid., p. 33.

20. Ibid., p. 44.

21. Ibid., pp. 52-54.

22. Ibid., p. 49.

23. Ibid., pp. 41-42.

24. Ivor Newby and Dennis Vann are friends of Mrs. Carey and introduced us to her.

25. Mrs. Carey's sightings have been described in many books and articles about the Loch Ness monster. See W. S. Ellis, *National Geographic,* 151 (1977):763.

26. Dowsing is a method employing a divining rod to locate objects at a distance. The evidence for its success is purely anecdotal and no known controlled study for dowsing has ever produced significant results.

27. We have a copy of Mrs. Carey's map, which includes a brief description of each sighting along with the names of the witnesses present.

28. M. Klein, R. H. Rines, T. Dinsdale, and L. S. Foster, op. cit., p. 79.

29. Ibid., p. 71.

30. Ronnie Bremner and Tony Harmsworth, founders of the Loch Ness Monster Centre, Drumnadrochit, Inverness-shire Scotland.

31. R. H. Rines, H. R. Edgerton, C. W. Wyckoff, and M. Klein, op. cit., p. 31.

32. Ibid., pp. 30-31.

33. These publications include *National Geographic* [25] and *Nature* [5].

34. Ms. Arnold was a member of the LNIB for several years and told us she planned the logistics for the August 9, 1972, attempt to locate the monster by dowsing.

35. Published in *Nature* [5] and *Technology Review* [2]. We were also able to study copies of the traces on display at the Loch Ness Monster Centre.

36. In addition to evidence from the sonar traces themselves, we were told independently by Holly Arnold, Ivor Newby, Gordon Menzies, and Dick Raynor that the sonar unit was hanging off the side of the boat at the end of a rope.

37. N. Witchell, op. cit., p. 147.

38. Copies of the original photographs were given to us by Tony Harmsworth, the co-founder of the Loch Ness Monster Centre, Drumnadrochit, Inverness-shire, Scotland.

39. N. Witchell, op. cit., p. 130.

40. T. Dinsdale, *Photography Journal,* 116, no. 1 (1976):18.
41. D. Raynor, private communication.
42. D. Meredith, *Search at Loch Ness* (New York: New York Times Book Co., 1977), p. 129.
43. Ibid., p. 130.
44. See [2] and W. S. Ellis, *National Geographic,* 151 (1977):763.

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