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ESSAY

Occam's Razor and Bayesian Measures of Likelihood Suggest Loch Ness Monsters Are Real Animals— An Example of Premature Discovery With Implications for Public Policy

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HIGHLIGHTS

Strong skepticism about the chances of a large animal in Loch Ness could have been reduced had scientific judgments shifted in real-time with the availability of new evidence.

ABSTRACT

Regarding claims of Loch Ness Monsters, what the simplest explanation might depend on how the evidence is assembled and judged. Eyewitness reports can be simply and plausibly explained away as misperceptions and occasional hoaxes. Many of the claimed surface photographs can be simply and plausibly challenged as misleading representations of natural phenomena as well as some deliberate faking. Simple explanations are less readily to hand for the underwater photos and the Dinsdale film, yet disbelievers have offered some. However, when the evidence is taken *as a whole*, the simplest explanation is that there are real animals responsible for these *three or four quite independent types of evidence*. A similar conclusion is reached by considering the evidence by a Bayesian approach, progressively modifying the estimated likelihood using each independent type of evidence. How the evidence accumulated matters a great deal: If sonar and photographic evidence had preceded rather than followed intense global interest based on eyewitness reports, the existence of Nessies might have become, by about 1980, widely accepted rather than disbelieved. Loch Ness Monsters might be the sort of premature discovery described by Gunther Stent. The best evidence came too late to influence media attitudes and popular belief. The difficulty of changing long-held views is illustrated not only in this instance but also within science overall, where hegemonic theories have for lengthy periods withstood the accumulation of considerable contradicting facts. Advice to policymakers should come from people who understand such aspects of science as its fallibility and the chanciness of which data come to hand when, thereby determining initial choice of explanations that then resist displacement.

KEYWORDS

Loch Ness monsters, Nessies, Occam's Razor, Bayesian methods, cognitive dissonance, science policy

INTRODUCTION: OCCAM'S RAZOR

Science fans often like to cite Occam's Razor[1] as a criterion for evaluating theories: The simpler or simplest explanation is the one to be preferred as more likely to be true. Centuries later, Einstein suggested the corollary that explanations should be as simple as possible *but no simpler*.

What is the simplest explanation for reports of Loch Ness monsters?

That depends on how much of the claimed evidence is taken into account.

If one considers only descriptions by eyewitnesses, misperception is a simple and plausible explanation. If, however, one takes into account also the evidence of film and sonar, tangible data that remain available for repeated re-examination, the scales tip in a different direction.

For nearly a century at least, many hundreds of people have reported seeing large unidentified animals in Loch Ness. The descriptions do not fit comfortably with any known aquatic or marine animals; uncomfortably, they evoke comparisons with long-extinct, long-necked creatures. The almost universally accepted, simple, explanation is that people have been tricked into misperception or misinterpretation of natural phenomena or known animals. That simple explanation fits with much that is known about human perception and with the manifest fact that Scotland and Scots welcome the tourist traffic and sales of mementos that flow from global interest in the claimed presence of unique animals in Loch Ness.

Few people have ventured to look any further into that claim. Those who do, however, become aware that eyewitness reports are only one among several independent types of evidence that these "monsters"—"Nessies" to their fans—are actually quite real animals. Those other types of evidence (Bauer, 2002) include echoes from sonar probes, photographs (some of them underwater), and moving film.

Occam's Razor should therefore be applied also to each of those other types of evidence, and, perhaps most tellingly, also collectively: If these three or four types of evidence, quite different from and independent of one another, are all compatible with the presence of large aquatic animals, is that not a much simpler explanation than that *similarly misleading* artefacts are somehow present in observations over many decades by sonar, *and* in underwater photography and surface photography, and even in moving film? Artefacts in quite different modes of observation, that all nevertheless manage to simulate animate creatures?

The existence of Nessies is then the simplest explanation for the totality of the evidence. Moreover, attempts by disbelievers to explain away individually each of the different bits and types of evidence do not stand up well to challenge.

Misperception

It is certainly more than likely that many people have misinterpreted natural phenomena, assisted to some degree by expectation based on publicized claims of the reality of Nessies. Indeed, quite a number of claimed sightings have been shown definitively to be misinterpretations of wind or wave or light effects, or of duck families; a detailed description of the many potential sources of misperception is set out in the Appendix. Among actual animals that could be mistaken for Nessies are seals, which are known to enter Loch Ness at times: I was momentarily excited, one morning in 1985, when a seal poked its head out of the water near the north shore of Urquhart Bay.

That misperceptions may be common does not, however, provide in itself a particularly compelling explanation for all of the many hundreds of independent reports (see for instance Mackal, 1976, pp. 83–92, 224–269), some of them simultaneously by separate groups of people at different places around the Loch; and the considerable number of reports from local people who are likely to be familiar with wave and wind effects and with local animals; for instance Mrs. Ross, whose kitchen window overlooked Urquhart Bay,[2] or Dick MacKintosh,[3] a lifelong fisherman with a holiday cottage overlooking Urquhart Bay.

Sonar

Many independent investigators over several decades using different types of sonar apparatus have recorded echoes that appear to be not from shoals of fish but from single objects larger than seals (Witchell, 1989, pp. 125 ff., 141 ff., 193 ff.). A number of those echoes have been from targets moving quite rapidly, typically coming up from or moving down toward considerable depths.

The simple explanation is that echoes from apparently single and large targets, moving rapidly, are owing to reflections from animals.

Alternative explanations offered by disbelievers for these echoes are neither specific nor simple: allegedly from the distant sidewalls of the loch, or from some sort of layers in the water, thermoclines or seiches (Shine, 2006). But no actually observed examples have been offered of this type of artefactual echo from a thermocline layer; nor of sidewall echoes that appear like moving animals, which could be sought quite easily in Norwegian

fjords, for instance.

Surface Photography

Quite a number of purported surface photos have been publicized. Some of them are almost universally agreed to be fakes or hoaxes: those by O'Connor (Mackal, 1976, pp. 104–106), Searle (Witchell, 1979, pp. 184-185; 1989, 137–139), Stuart (Whyte, 1961: facing p. 44; Witchell, 1989: pp. 82–84).

Several are regarded as genuine by some but spurious by others, most prominently the most iconic one, the "Surgeon's" (Martin & Boyd, 1999; Shuker, 1995, pp. 87–88); also that by Cockrell (Mackal, 1976, pp. 103–104).

Others are accepted as not faked but alleged by some critics to be misinterpreted: the MacNab (Mackal, 1976, pp. 103, 273–276), the Hugh Gray (Mackal, 1976, pp. 94–96, 114), the Tait,[4] and again that by Cockrell.

All the photos are independent of one another, so each calls for an individual explanation. Not all of them have as the simplest explanation, faking or misleading representation of natural phenomenon or common animal.

Overall, that some photos have been faked speaks neither for nor against the possible reality of Nessies: If they are real animals, some people would still find reason to fake pictures of them.

Underwater Photography

Attempts to explain away the underwater photographs have suggested that they somehow caught tree-stumps or rock formations or dumped machinery whose appearances happen to lend themselves to interpretation as animals of the type of reported by witnesses, namely, with long necks, reptilian facial features, and flipper- or paddle-shaped limbs.

Is it really a simple explanation, that these photos just happen quite often to look similar to eyewitness descriptions, in a body of water where sonar also appears to confirm eyewitness reports?

Moving Films

The iconic one was obtained by Tim Dinsdale in 1960. It has been featured in many documentaries and has been posted on the internet by Dinsdale's son.[5] The only attempted explanation by disbelievers is that the dark hump that looks rather like an upturned boat is actually a small fishing dinghy that just happens under those particular lighting conditions to look not like a boat.[6]

Readers are invited to look at the film for themselves in order to judge whether that explanation, admittedly simple, is however unconvincing. Beyond that, several of the most dedicated disbelievers have tried to film a boat in a way that makes it look like a dark hump, and they have been uniformly unsuccessful.[7]

The Simplest Explanation for all the Claimed Evidence

Both Occam and Einstein, I suggest, would agree that the totality of the evidence makes it perfectly plausible that Nessies are real animals that spend most of their time at considerable depths, appearing only rarely at the surface. It seems not only complicated but also difficult to believe that sonar equipment and photographic devices would rather consistently deliver misleading observations that are all readily compatible with what eyewitnesses have reported. Particularly perhaps since some of the underwater photos were obtained at the same time as sonar units pointing near the camera recorded large moving targets.

Admittedly, no well known creatures fit comfortably with all the evidence, and definitive proof awaits the discovery of an actual live or dead specimen, but several different types of well-known air-breathing marine animals do swim at great speeds and can dive to great depths, sometimes spending considerable lengths of time there, for instance whales, seals, leatherneck turtles (Bauer, 2020).

BAYESIAN PROBABILITY ESTIMATES

The Bayesian approach to estimating probability progressively modifies the estimates as evidence becomes available, or as several independent types of evidence are taken successively into account. Sturrock (2013) has illustrated how this approach can be applied semi-quantitatively to such controversial matters as the authorship of the works conventionally attributed to "Shakespeare" (making a strong case for Edward De Vere, Earl of Oxford, rather than the actor from Stratford on Avon).

The process starts with an initial guesstimate, the "prior probability." That starting point matters not very much, because as independent evidence becomes available, estimates become progressively better no matter what initial "prior probability" had been postulated.

The "Bayes Factor" compares the odds on the new evidence favoring or not favoring the hypothesis being tested, or comparing how the evidence fits with that hypothesis rather than with an alternative. The estimated "posterior" probability of the hypothesis being tested is modified by the "Bayes Factor" whenever new evidence

is considered.

Here, the hypothesis is that Nessies are real animals. The nature of the evidence does not allow for definitively quantitative calculation of Bayes Factors; there is no precise information available about, for instance, what proportion of claimed surface photographs are hoaxes, and what proportion are misinterpreted or misleading; nor about how frequently sonar echoes from apparently moving large targets in deep water are *not* large moving objects at all. However, as Sturrock (2013) illustrates, one can translate *rational judgments* of likelihood into reasonable numbers for probabilities or odds. Similarly, medical practice can be guided by Bayesian reasoning as to diagnosing, testing, and treatment, by giving appropriate quantitative form to the commonly made qualitative judgments based on general experience (Mitchell & Lucey, 2011): Very unlikely = <10%, Unlikely = 10% to 33%, Uncertain = 34% to 66%, Likely = 67% to 90%, Very likely = ≥90%. In the following, these are expressed as probabilities and odds by averaging and rounding: Very unlikely, p~0.05, odds 10:1 against; unlikely, p~0.25, odds 4:1 against; uncertain p = 0.5, odds 1:1; likely, p~0.75, odds 4:1 in favor; very likely, p~0.95, odds 10:1 in favor.

For the reality of Nessies, most people who had not yet taken any serious interest in the matter would likely assign quite a low prior probability, and Nessie fans can agree on that with disbelievers. But is the prior probability "unlikely" or "*very* unlikely"?

The hypothesis is a previously unidentified, large marine creature, possibly related to folklore and legend, occasionally seen at the surface, in a very deep lake that was part of the ocean perhaps ten thousand years ago. This is reminiscent of sea serpents, which may or may not exist; and of the legendary kraken, which turned out to be folklore possibly based on the really existing giant squid. There is also the completely unexpected discovery of the coelacanth, thought to have been extinct as long as the dinosaurs and plesiosaurs, as well as the megamouth shark, not previously known even from fossils. Depending on the degree of knowledge of those details and the weight given to them, some people would no doubt say p = 0.05 for Nessies, while others might be willing to go as high as p = 0.25.

The evidence began chronologically with eyewitness reports of phenomena interpreted as of animal origin, in particular a spate of publicity beginning in 1933 and continuing for several years. Some possible sightings before that have been claimed, including one from 1930 reported to the local newspaper. Many reports come from local people familiar with the area. Some significant reports stem from well-known and respected people, some of them with rather impressive and relevant credentials. On several occasions, separate groups of people at different points on the Loch reported seeing the same thing. Eyewitness accounts were first collected and published by Gould (1934); later significant collections have been presented by Whyte (1957), Mackal (1976), and Witchell (1974).

It seems highly unlikely that *all* of these reports represent misidentifications of natural phenomenon including boat wakes, birds, seals, and so on (detailed in the Appendix), even if the first publicized sighting was a deliberate lie perpetrated to bring tourist business to local hotels (Bauer, 1986, pp. 3–4), and even if long-standing legends about water kelpies and water horses prompted wishful misidentification. As Watson (2011) has shown, reported sightings of such mythical creatures involved Loch Ness much more frequently than other Scottish lakes. So the odds that eyewitness reports of the existence of real but unidentified animals is surely somewhat better than 1:1, a bit better than p = 0.5, say p~0.6, odds of 1.5:1; in other words, serious examination of all the eyewitness reports to date would likely be reflected in a somewhat "positive" Bayes Factor that would modify the low prior probability to a somewhat higher posterior probability; strong disbelief might morph into slighter disbelief, very unlikely might become just unlikely or quite unlikely.

The 1930s also brought some photographic evidence: the iconic but controversial "Surgeon's" photograph, the also controversial one by local resident Hugh Gray, as well as some referred to in writings but no longer available. Surface photography, reviewed in detail earlier, is a truly mixed bag. Despite known fakes, some at least are genuine and appear to confirm eyewitness reports. Such apparent confirmation surely strengthens belief in both these strands of evidence. It seems highly unlikely that in a location where many people report seeing large animals, several genuine photos of natural phenomena should misleadingly mimic those reports. The probability of real Nessies, on the basis of surface photography, might again be something like 1.5:1, p~0.6.

There were also a couple of moving films allegedly obtained by Nessie hunters in the 1930s. The Irvine is widely believed to be a hoax (Witchell, 1974, p. 57–59), but one obtained by the unofficial Mountain expedition was shown at a meeting of the Linnaean Society (1934), where experts on marine life were unable to identify what the film shows in terms of known creatures, be they seals, otters, or whales. This in itself could hardly deliver for real Nessies a probability of more than p~0.55, odds 1.1:1, especially since the only available evidence is a written report and not the film itself.

However, in 1960 Tim Dinsdale obtained the film mentioned above, now available for everyone to see on-

line and for which the most determined activist disbelievers have failed to offer a viable alternative explanation to a large fast-moving animal. It is highly unlikely that any alternative explanation can be found; Nessie p~0.95, odds 10:1.

The Dinsdale film led to a decade of organized searching that included an impressive number of independent sonar findings, by a variety of hunters and instruments, apparently from large moving underwater objects, sometimes tracked for a time during motion; see above. That these frequent independent findings with various equipment could all be owing to artefacts mimicking single large moving targets seems between unlikely and highly unlikely; odds against that and for Nessie, say 7:1, p~0.85.

The underwater photos, some of them with simultaneous sonar echoes, described earlier, present a similar level of implausibility, that these could be artefacts that mimic animals of the sort described by eyewitnesses; again odds 7:1, p~0.85 on real Nessies.

The final posterior probability is estimated by modifying the prior probability by the odds from the various types of independent evidence. The overall odds are obtained by multiplying the odds from each individual type of evidence. For eyewitness followed by photos followed by film followed by sonar and then underwater photography, we have odds of 1.5 x 1.5 x 1.1 x 10 x 7 x 7; cumulating to ~1200:1 to modify the initial prior probability.

Even the most pessimistic, disbelieving prior probability of 0.05, or 10:1 against, becomes quite likely when all the evidence is included, better than 100:1 that Nessies are real. If the initial guess was just unlikely rather than very unlikely, the odds on Nessie would be even better, say 300:1.

Thus the Bayesian approach to estimating probabilities converts initial disbelief in the reality of Nessies into reasonable belief or stronger, consonant with the qualitative arguments based on Occam's Razor.

This exercise illustrates more than one significant point. So long as sufficient evidence accumulates, the Bayesian approach yields conclusions that are relatively unaffected by the initial guess, the prior probability. It is also evident that the strongest evidence has the greatest influence.

FACTS AND CONVENTIONAL WISDOM

The conventional wisdom about Nessies, strongly maintained by the popular mass media, is that they are figments of myth-inspired misperception and wishful thinking, supported happily by Scotland's tourist industry and local entrepreneurs. Yet the actual evidence judged by Occam's Razor and Bayesian methods seems rather to support the real existence of Nessies.

In the 1930s, the only evidence was from eyewitnesses, a couple of photos, and the Mountain film. There were fewer sightings and photos than have now accumulated, so instead of Bayesian factor 1.5 x 1.5 x 1.1 one might venture 1.4 x 1.4 x 1.1 = 2.2. With a prior probability of p~0.15 (0.05-0.25), this yields a posterior probability of p~0.33, on the border between unlikely and uncertain. But there had also been a highly publicized hoax in the early 1930s when a big-game hunter sponsored by a newspaper claimed to have found tracks of a monstrous creature on the shore which, it turned out, he had secretly manufactured using a memento made from a preserved hippopotamus foot (Witchell, 1974, p. 60). So it was eminently reasonable in the 1930s not to take seriously the possibility of real Nessies. The media concluded, quite naturally, that the eyewitness reports were mis-identifications and that continuing claims of wondrous creatures in Loch Ness could be ascribed to tourist-seeking publicity. For a couple of decades, that remained the way in which the popular media around the world treated the topic of Loch Ness Monster.

The Bayesian method of considering evidence progressively was applied just now in chronological order. The evidence available in the 1930s produces a Bayes Factor that does little to modify initial disbelief; the strongest evidence came only later, with the Dinsdale film of 1960, many sonar contacts from the 1950s to the 1980s and still continuing, and underwater photos in the 1970s. This suggests an interesting thought-experiment. What might the conventional wisdom be now about Nessies if global interest had *not* been aroused by eyewitness reports in the 1930s?

Imagine that the first report of something unusual in Loch Ness had been the sonar observation by a fishing trawler in 1954 (Whyte, 1961, facing p.45), of something large in deep mid-water; and that this report led to the confirming further sonar echoes reported by students from Cambridge University (Witchell, 1989, p. 118) and by electronic engineers from the University of Birmingham (Witchell, 1989, p. 125); further confirmed by the many contacts made by the Loch Ness and Morar Project in 1982 (Harmsworth, 1985, pp. 22–24; Witchell, 1989, p. 190).

Surely the media, and thereby the general public, would have taken the possibility of large creatures in Loch Ness as quite plausible because indicated by "scientific" evidence. If Tim Dinsdale had then obtained his film a bit *later*, it would have been immediately accepted as not only confirming but even advancing beyond the earlier scientific evidence. Eyewitness reports would of course have been given much credence had the sonar evidence

come first, followed by some surface photographs; and the underwater photographs with simultaneous sonar contacts by the teams of Robert Rines would then have been hailed as marvelous culminations of exploratory science.

Considered in this way, the 1930s' furor over Loch Ness Monsters could be described as what Gunther Stent (1972) labeled "premature discovery," a quite genuine discovery made before the intellectual climate in the scientific community was adequately prepared to appreciate it.

It is well-known from human psychology and sociology that facts alone, including "scientific" facts, do not suffice to change long-ingrained beliefs. Human psychology seeks to avoid cognitive dissonance and finds ways of ignoring or not noticing facts that do not fit with pre-existing beliefs (Festinger et al., 1956). The conventional wisdom about Nessies had been formed in the early-to-mid 1930s, with the mass media concluding that it was a "silly season" phenomenon. The powerful evidence that started to come in almost three decades later—Dinsdale film, sonar, underwater photos—has not sufficed to persuade official sources or the media to retract their long-held opinions and to admit to error and to misleading the public.

IMPLICATIONS FOR SCIENCE AND PUBLIC POLICY

It is not only with the Loch Ness Monster that a conclusion reached prematurely continues to dominate public discourse even as contradictory facts accumulate. The same psychological and sociological factors are in play in every human activity, including science. For example, the early-20th-century belief in the heritability of behavioral traits led to the forced sterilization of tens of thousands of Americans for many decades, as late as the 1980s (Lawrence, 2012; Reilly, 2015).

The critical point is that the specialist experts on any given topic are, like other human beings, predisposed to ignore or not to notice, and certainly to resist, evidence that seems incompatible with their acquired or established beliefs. It follows that advice to policymakers should come from individuals able to understand the technical issues but not themselves actively involved in the relevant research activity. Thus for advice on scientific matters, the best sources would be historians and sociologists and philosophers of science, or individuals in the relatively new discipline of Science and Technology Studies which incorporates history and sociology and philosophy of science as well as political and other aspects. The Presidential Science Advisor should be someone well-qualified in those areas rather than, as is now the practice, an active scientist.

Furthermore, when there is much controversy over some scientific or medical issue, there is needed some publicly open and visible procedure for resolving the matter. Science, just as much as other human activities, is in need of fact-checking to ensure that its theories remain consonant with objective reality (Bauer, 2021). Since the experts most directly involved have strongly ingrained views that may not have been modified by accumulating contradictory evidence, modern society needs something like a Science Court (Bauer, 2017, chapter 12).

NOTES

[1] William of Ockham, ~1285-1350, philosopher, Franciscan friar.

[2] Personal communication from Mrs. Ross's son, whom we knew for many years though renting the chalet below his cottage on the south shore of Urquhart Bay.

[3] Personal communication. MacKintosh was a highly respected Inverness lawyer; he and his wife became our good friends, but it was years before he told us of his personal encounter with a Nessie—a "huge gray mass" that surfaced not far from his fishing boat.

[4] An iconic "multiple humps" that are actually a side view of wake formations; published in 1969 in a newspaper (*Sunday Express*) and reproduced in various tourist brochures, for instance in Owen (1980–1986).

[5]. https://www.themanwhofilmednessie.com/tims-nessie-film.html

[6]. Adrian Shine, "The Dinsdale Loch Ness Film. An Image Analysis." https://mega.nz/file/JX530AKC#FXp99K_F2IpVjy6Q3Ijh3ukb_0jnThXBaKS35r0Xq8w. Shine's analysis was critiqued in Henry Bauer, "To whom it may concern", https://mega.nz/file/lGIWSDCI#0W8JA8obFfPDq1LuObT-GhtpU6CrDdljfcy_mv65yt0

[7]. One of their failed attempts is shown in *Lake Monsters*, a Discovery Channel documentary produced by the BBC (Bauer, 2002); see also https://henryhbauer.homestead.com/DinsdaleFilm.html

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APPENDIX: LOCH NESS MISPERCEPTIONS

First Hand Observations Between 1985 and 2004, During Several Annual Weeks at Loch Ness

At any ocean or large lake, there are many ways to be fooled into thinking that an animal is being seen even when no animal is actually there. At Loch Ness there are a great many things that can easily be mistaken for a Nessie.

When the water is a bit choppy, the shadows of waves can look—especially out of the corners of one's eyes—like solid objects knifing through the water, surfacing and quickly submerging again; seeming like some dark object(s) moving sideways to the direction in which the waves are rolling.

When the water is *very* choppy, the tops of the waves break into white foam and these white caps or "white horses" can make it seem that those black objects—which are really the shadows in the waves—are producing splashes.

When the water is calm, there are many ways to be fooled: When there is very little wind, the water can be like a black mirror, and little gusts of air touching the surface of the water can look very much like wakes, moving very rapidly or quite slowly. More commonly, most of the surface is slightly wind-ruffled and has a silvery sheen—except in patches of calm where it still looks black. Those patches can seem very much like black objects in the water, especially when one is close to water-level or at a distance; only from a high elevation (or through binoculars) can one see that the "object" is flat along the surface of the water and not poking up out of it. These patches of calm can stay unchanging for minutes at a time; or they can seem to move quickly; and they can change shape in many intriguing ways. Sometimes these calm patches last for a very long time, perhaps because there is an oily film on the water.

Things that seem to be skating over the water may be reflections of things moving on the other shore or flying above the water or above the hills. Roy Mackal was temporarily misled by some low-flying ducks that were invisible against the dark shore but whose reflections were easily seen, appearing to move rapidly on the water.

Reflections of shadows on trees on the opposite shore can look like black objects lying on the shore or in the water just a little off the shore.

Mirages can make boats look two or three times as high as they actually are. Mirage effects are greatest when the air is warm and when one is standing close to water-level. Looking up or down the length of the loch

shows stronger mirage-effects than looking across it. When the conditions favor mirages, a good place to observe them is from the spit of land between the Caledonian Canal and the River Oich, at Fort Augustus; or from a boat.

Birds

Birds can leave amazingly big wakes on glassy water. Often one cannot even see the bird itself (or birds: it may be a whole family, usually of ducks). Some of these birds can submerge, stay under for several minutes, and come up again so far away that one might miss the re-surfacing altogether. Almost every late summer evening one can see this in Urquhart Bay: a mother duck taking her youngsters out for training runs. Sometimes they leave a clear V-wake, and at water level and without binoculars one may not see the ducks themselves. Sometimes they suddenly submerge and reappear only after several minutes, often quite far away. Once I was stunned when a line of them suddenly appeared with a splash on the surface, momentarily making me think that a Nessie had surfaced with its neck lying along the water.

Tell-tale signs that wakes are from a flock of ducks are that occasionally the V-wake becomes irregular, as some of the little ducks move a bit faster than others and break ranks. Typically too, the wake does not proceed at a smooth pace but in "jumps", fast for a while and then slowing almost to halt, then speeding up again. A film Richard Raynor took in the 1960s, long thought to be of a Nessie, shows those tell-tale spurts, and Raynor himself realized years later that it had been a duck family; the mis-interpretation was almost inevitable since the camera had been at near water-height. Height above the water makes for much sounder photography as well as observation.

Boat Wakes

Boat wakes can persist for long times, half an hour or more, because the Loch is so wide. When it is very calm, a wake may even reflect off the shore and travel back again in the opposite direction. Very powerful wakes are generated by some of the Jacobite tourism boats that cruise from Inverness to Urquhart Castle at various times during the day and evening. A single wake-arm can look like a succession of humps; and as the wake *approaches*, it can look like humps moving *sideways*. The wavelets that form the wake do not all dissipate at the same rate. One part of a wake often keeps going long after the rest of it has died down, and then that remaining segment of wake can look very much like a single hump or like two or three humps—and quite unlike a fresh boat wake.

Sometimes one of these waves can seem to stay in one place. If it is approaching and one's height above the water is not enough to recognize it as a wave, then the shadow at the side of the wave can look quite like something dark emerging out of the water, and the white splash at the front of the wave as it curls over can add to the illusion.

At about 11 o'clock one bright morning in 1983, I watched a black object surface and submerge three times, splashing every time, near the middle of Urquhart Bay. I shot some Super-8 film (with a 64 mm telephoto lens), and later looked at that film many times without being sure what I had filmed. But eventually, having watched the waters of Loch Ness a lot more, I finally realized that I had seen and photographed one of those bits of a past wake that is just like a single wave staying in one place and looking like a solid object bobbing up to the surface and down again. A tell-tale sign that something is a wave or a wake effect: ***if it repeats itself more or less regularly***, it is much more likely to be water action than an animal; that instance I had filmed repeated itself three times.

Bird Wakes as Well as Boat Wakes

Wakes can be very deceptive. When two wakes cross one another, the effect can look even more like a series of humps. Several published photos, and several videos shown on television, and which were described as possibly being Nessies, were definitely wakes.

SPLASHES, RIPPLES, RINGS...

Other disturbances in the water, too, can make one imagine that a big animal is splashing around when the real explanation is something else. Some time before Tim Dinsdale got his actual film of a Nessie, he thought he had filmed one closer to shore, only to realize when viewing the film that it was water eddying around rocks where a small river was flowing into the loch.

Rings of ripples form: from rising fish, or from bubbles of gas rising from the bottom, or from insect hatches. In calm water, the rings of ripples from ducks or fish rises can become quite impressively large.

Little fish quite often leap right out of the water, and occasionally quite large salmon do. When one has just seen a splash out of the corner of an eye, one cannot properly judge how large it was, let alone how large was whatever produced the splash. (One can watch salmon jumping at several places not far from Loch Ness. Near Beauly, good salmon-viewing spots are below Kilmorack Dam and at the Falls of Rogie. Farther away, the Falls of

Shin near Lairg are a favorite spot to watch salmon leaping up waterfalls. South and east, at Pitlochry on the A9, there is a fish ladder with underwater viewing area.)

Reflections from the Water

Reflections can be very misleading. In fact, most of what we "see" "on the water" is not actually there but is actually a reflection off the surface of the water, of something in the sky or on the opposite shore. Sometimes a light, or a little cloud, or quite a small object on the shore, can cast a very long reflection. One morning two of us saw a long vertical whitish object near the opposite shore, about a mile and a half away: We thought it was perhaps a sailboat or a windsurfer, but through binoculars it was revealed as the shiny cover (plastic?) of a dinghy (inflatable?) reflecting the sun.

Genuine Nessie sightings are likely to be subjectively convincing; many eyewitnesses reported their amazement at the size of the monster, or at its power as it sweeps along. Of course, subjective conviction is not objective proof.

Maybe...

So there are many ways to be fooled into thinking one has seen a Nessie when one actually hasn't. But the opposite is also possible. We expect Nessies to be *big*: but even big animals don't always *look* big, depending how much of themselves they show. If Nessies breathe air, as most searchers believe, perhaps they could do so by poking just the tips of nostrils out of the water. Then what look like rings made by feeding fish could be from Nessies. Almost every summer evening, off the western shore and parts of the southern shore of Urquhart Bay, innumerable circular ripples appear. We naturally take them to be insect hatches or rising fish, but maybe some of them could be Nessies . . .