

LOCH NESS PROJECT

I recently received a copy of the Project's published papers on the work they have undertaken over the past few years. Over 270 pages, some of which are given over to graphs, charts, etc, it is an impressive document. Some of it is above my head, the chemical analysis for instance, but there is much of great interest. While I acknowledge that it is not 'monster' as such, I feel that the more that is known about the loch and how it is affected by outside elements the nearer we will be to solving the mystery. Introduction; Historical Background and Introduction to the Recent Work of the Project. Hydrography; Loch Ness Bathymetric and Seismic Survey, December '91. Chemistry; Results of a water Chemistry Study of Loch Ness. Sediments; Review of current Work on Loch Ness Sediment Cores. Loch Ness Sediments: A Preliminary Report. The use of a Sediment Core to Reconstruct the Historical Input of Contaminants to Loch Ness:(PCBs & PAHs). Profundal Zone; The Profundal Fauna of Loch Ness and Loch Morar; The Spatial Distribution of Benthic Ostracods in the Profundal Zone of Loch Ness. Pelagic Zone; The Food and Feeding Relationships of Pelagic Fish in Loch Ness; Large and Small Organisms Detected in the open Waters of Loch Ness by Dual-Beam Acoustics; Spatial Distribution and Diurnal Migration of the Pelagic Fish and Zooplankton in Loch Ness. Spatial Diversity; Fish Habits in Loch Ness; Allochthonous Organic Inputs as an Explanation of Spatial Biomass Gradients Observed in the Pelagic and Profundal Zones of Loch Ness. Postscript; Surgeon or Sturgeon?

Reference is made in the introduction to it being some ninety years since Sir John Murray and Laurence Pullar published the first part of their pioneer hydrographic survey. After the early pioneer work the biology of the loch remained rather neglected until Dr Peter Maitland's multi-disciplinary survey of 1977-80, which has remained the definitive background for further studies. 1993 marks two other anniversaries. It is now 125 years since the 'Inverness Courier' (8th Oct.1868) first referred to the loch's unusual tradition, and sixty years since the same newspaper (Anon, 1933) coined the term 'Monster'. This tradition has been blamed, possibly somewhat unjustly, for the scientific reticence regarding the loch. As the roll of distinguished scientists shows, this is hardly the case, but equally it remains to be explained why Britain's premier body of fresh-water has not received more attention. One reason could be the inadequacy of much freshwater sampling equipment when confronted with windy surface conditions and water depths of 200 metres plus. While the Monster tradition may have attracted enthusiastic amateur naturalists but few professional zoologists, it did attract trained engineers, who mounted some quite large-scale expeditions to provide the logistics for the novel methods of protracted acoustic and underwater camera monitoring. This formed the base for the Loch Ness and Morar Project's tradition of improvisation, and, as the general scientific possibilities became clear, so some marine equipment found its first freshwater use in Loch Ness. The Project has designed and built its own gravity-coring apparatus for deep-water and for use from smaller vessels. The wide bore (10.3cm) was originally developed to collect the large volumes of sediments necessary to detect chemicals present in minute concentrations. The system has also proved very effective for quantitative benthos studies as well as sediment mapping. Very satisfactory 3.0m cores can be taken with this system. The Project has, by courtesy of Mr R.A.Bremner proprietor Official Loch Ness Exhibition Centre, a loch-side H.Q. as well as harbour and laboratory facilities. This permanent loch-side presence enables Adrian and Marilyn Shine along with John Minshull to conduct field-work, each year volunteers are recruited to support the various programmes. During the past three years it is gratifying to report that forty collaborators have responded with research on many aspects of Loch Ness, including a continuous three-year multi-disciplinary plankton study by the University of Lancaster, to which the Project has contributed the field-work. At least seventeen B.Sc., M.Sc., M.Phil. and Ph.D. dissertations and theses, wholly or partly devoted to the loch, have been completed or are in preparation.

and the Project's Sediment group is also being co-ordinated by the Environmental Change Research Centre at University College London. During 1992/3 a certain amount of material was presented at meetings of the Institute of Fisheries Management, the Societas Internationalis Limnologae Theoreticae et Applicatae in Barcelona, and the British Ecological Society; further papers and posters featured in the 50th meetings of both the Scottish and London Freshwater Groups. Additional specialist will follow in due course.

The 1991 Bathymetric and Seismic Survey was designed to resolve any remaining controversy over the maximum depth of Loch Ness, and to prepare for the Project's deep-coring programme. This is the Rosetta Project (Recovery of Sediments Enabling Translations to Acoustics) and is designed to complement the European Community Rebecca Project (Reflection from Bottom, Echo Classification and Characterisation of Acoustic Propagation). This is a seismic programme for which the British participant is Dr Bryan Woodward of Loughborough University of Technology. The survey was completed in five days between 2nd and 6th December '91. That time of year was chosen because the loch is largely isothermal in winter, whereas during summer the complex internal seiches in the loch create unpredictable and complex velocity profiles and refractions of echo-sounder signals. The deep basins were of primary interest, and survey lines were calculated to cover all depths below 50m and a 50% coverage of the rest. The first day was devoted to installation and calibration of equipment including the navigation equipment which used the US Dept. of Defence NAVSTAR global positioning satellites. Days 2-5 were the survey days, with a total survey time of 31 hours, and a distance of 288km travelled at an average speed of 5.5 knots. Over 200,000 bathymetric soundings and 0.8 Giga Bytes of seismic profile data were recorded. The results show a positive similarity between the 1991 and 1983 surveys. The general regularity of the loch basin was confirmed, although some local irregular rock facets in the rocky side-walls caused some acoustic difficulties. It had been suggested by Mr George Edwards that an area of increased depth lay at the base of the 'wall' off Urquhart Bay. The presence of a gully approximately 3.0m deep was confirmed. The seismic data are of considerable interest and show deep strata, confirming that corers capable of extracting cores in excess of 10m length would be needed.

The maximum depth was of particular interest. When the Vickers Pisces submersible was undergoing trials in Loch Ness in 1969 it had been claimed that it reached a depth of 820ft (250m) and that a sonar depth of 970ft (295m) had been obtained a quarter of a mile south of Urquhart Castle. The '91 survey found a maximum depth in the North Basin, of 745ft (226.96m), this was a little less than that recorded by Murray & Pullar in '83, and was recorded 1.0km further N.E. at a position approximately 1.0km south of Urquhart Castle. The maximum depth found in the South Basin was 726ft (221m), again a little less than the 739ft (225m) recorded in '83.

In May 1992 students from the University of Wolverhampton carried out initial water sampling and chemical analysis at Loch Ness, to consider the logistics and possible value of a more ambitious programme. Samples were collected from 81 input streams/rivers, the River Ness (output) as well as both the North and South Basins of the loch. The results presented in the paper are incomplete but it is felt there is considerable potential for catchment-based studies of water chemistry. The Loch Ness catchment area extends almost from coast to coast.

The sediment mapping and coring programmes carried out by the Project are now beginning to contribute to the understanding of Loch Ness, Britain's greatest volume of fresh-water. Many small lochs, particularly to the south of the Great Glen Fault, have become very acidified, some to the extent of losing their fish populations. A number of these lochs are being presently studied by a team from the Environmental Change Research Centre at University College London. In Loch Ness there is very little evidence of acidification, probably it is the sheer volume of water that is acting as a buffer against it. It is well established that a significant cause of acidification is atmospheric contamination. The numbers of microscopic 'carbonaceous particles' falling into a lake indicate the extent of sulphur pollution. These spherical particles result

from the burning of fossil fuels, especially oil, and have increased dramatically in sediments from about 1940, when that form of energy became increasingly used for power generation. Loch Ness cores taken in 1990 by the Project show typical concentrations of these particles, beginning between 1850 and 1870, rapidly increasing between 1949 and 1960, reaching a peak in the 1970s.

The silica frustules of diatoms remain intact within the sediments, and can be identified. This record allows reconstruction of pH values. Despite the sulphur contamination, acidity has remained relatively constant since 1850, agreeing well with the present pH of 6.5.

Locked in the sediments, pollen grains from the loch catchment's vegetation also endure for thousands of years. Dr Sylvia Peglar, at the University of Bergen, has been able to show events over the last three thousand years as tree pollens gradually give way to herbs and cereals. Then increase again in recent past as new species of conifers were established in plantations. A higher resolution method of dating is available to reveal the sedimentation rate and date more recent events in the cores. Used by U.C.L. it is based on the relatively rapid decay (22.26 years half-life) of the naturally occurring radio-isotope ²¹⁰Pb, and has dated Loch Ness cores back to 1830, covering almost all the changes brought about by industrialisation. The chronology can also be checked by the presence of some rather less natural caesium isotopes. The 1963 peak in nuclear bomb fall-out from atmospheric testing is faithfully recorded in the sediment 9.0cm down, and the long dark accusing finger of Chernobyl points out from the 3.0cm mark on the graph.

The bulk of the sediments are derived from terrestrial vegetation, rather than productivity within the loch. Differing features in the loch's catchment have considerable influences on the character of the sediments. Prevailing weather patterns mean that the bulk of the water enters the loch from the south-west end, which also brings the majority of organic material with it, particularly peat and leaves. A sediment map prepared from the Project's short-core programme clearly shows that each inlet contributes different characteristics to the sequence of sediment build-up. It has been confirmed that the rise on the loch bed opposite Foyers is composed of coarse mica sand brought down by the river, and while the same is true off Invermoriston there is a greater percentage of vegetable detritus there. Clays are exposed at shallow sediment depth at the loch's northern end towards Dores. Overall sediments are focused towards the deeper water, where the contemporary rate of sedimentation exceeds 1.0cm per year in the North Basin. The most interesting discovery about the Loch Ness sediments is that they are laminated. The 200m plus depths provide an exceptional stable resting place for silts and clays, which in shallower waters would be disturbed and resuspended. Thus, characteristic light/dark 'couplets' are preserved. The nature of the sediments suggests the possibility that the laminae are precipitation controlled annual features. A Ph.D. thesis funded by the University of Wolverhampton is now devoted to determining the nature and composition of the laminations. To this end the Project has set up Project Hour-Glass, to remain on the loch bed for a year. It concentrates the sediment into a narrow tube, in order to emphasise any differences in the sediments monthly character. The quality of the laminations establishes Loch Ness as a premier site for the study of climate change in Great Britain. Once the basic language of the laminations is understood, each divided core will reveal a catalogue of information about the history of Loch Ness. That history begins with glacial clays deposited by retreating ice some 12,000 years ago. The Project's long-core programme (Rosetta) is steadily being driven towards those clays. This will recover pollen and mineral records of such events as the general re-advance of the ice (often referred to as the Loch Lomond stadial) to post-glacial burst of productivity within the loch and its catchment, and to man's arrival in the Great Glen. It may also be possible, by looking for marine species of diatoms, to resolve the question of whether or not the sea entered Loch Ness.

In 1990 one feature of particular interest that was discovered was a disturbance in the rate of sedimentation, represented by distinctive light grey clay layer. Initially observed at 30-50cm sediment depth throughout the dark brown organic deposits of the North Basin. This feature was

widespread throughout the loch. In cores from the South Basin, instead of the thick clay layer, it appeared to be represented by much coarser material and layers of intact terrestrial vegetation. Which strongly suggested a major flood. ²¹⁰Pb dating clearly suggests a major event in the latter part of the 19th century. Throughout the summer of 1992 the layer was traced along and across the loch, and, in the North Basin, was tracked to the mouth of Urquhart Bay. A transect of three cores showed the clay layer to be thickest nearest to the Bay, capping no less than 50cm of coarse sand, before resumption of the normal pattern of deposition. The sand layer tapered away with distance from the Bay, and the clay thinned to the north and south. It is thought that the great flood of 1868 is the most likely cause of this huge outwashing of material. A closer study of 27 short cores showed the disturbance to be more complex than was first observed. In the deeper parts of the North Basin the grey clay layer overlies a fining upwards section of dark brown silts. It is suggested a turbidity current, triggered by the flood, plunged down the slopes of Urquhart Bay towards the deep North basin cutting the small gully at the base of the wall 200m down. In the narrower South Basin it was discovered that the coarser particles and vegetation were only part of a thicker sequence of material, each capped by a much thinner, but clear, light clay layer. Here, similar powerful erosive currents, under the extraordinary conditions of the great flood of 1868, originated not only from the rivers but also extended right across the loch bed from the Horseshoe Scree. The particles of sand were deposited first, then the silts, twigs and vegetable matter, and finally, perhaps months later, the last of the fine clay particles settled to blanket the basin floors.

The northerly location of the loch makes it possible to relate tephrae (microscopic glass shards), enclosed within the sediments, to Icelandic volcanic eruptions. The first depopulation of the Highlands, during the Bronze age, was coincidental with one resultant 'volcanic winter'.

In conclusion, 'Loch Ness should not be seen as some untouched and pristine cul-de-sac. It is very far from that; it is an open-ended time capsule, packed with the footnotes to very broad events, including the coming of man to the Great Glen and his activities here and further afield. Sedimentary records have proved to be a remorseless treatise in cause and effect, and give dramatic confirmation of man's power to change his environment.' There is still a mass of information which I have not yet extracted from, but this Newsletter is filling.

It was announced early in June this year the Project had successfully recovered a 6m core from their fixed station in mid-loch a little south of the Clansman. The bottom 1.5m of this core seemed to be glacial clay, so perhaps they have reached the 'bottom'. However when I spoke to Adrian he said that at the very bottom of the clay there appeared to be traces of grit, which could indicate a layer of glacial clay overlying the lowest layers of sediment. That could be the result of the re-advance of the ice during a period often referred to as the Loch Lomond stadial. There is also the theory put forward in 1979 that there were ice-dammed lakes far up the Great Glen, water from these being released and forced northwards through Loch Ness in a cataclysmic period of only 48 hours. They, the lakes, could also have been the cause of the raised beaches found in some areas of the Great Glen and adjoining glens. The core has been divided and Wolverhampton and Plymouth Universities have a piece each to work on. I asked if the submarine had been used to obtain the core, but while it did assist it was only in a very minor way. It checked the corer when it reached the bottom to make sure it was perpendicular to the loch floor. They also used the robot arm to remove the safety catch, fitted to ensure the corer did not activate before being in the correct position.

This is all the space I have this time. Will be at the loch soon, Abriachan, 30th July to 9th August. Hope to see Alastair and Sue Boyd there, they will be at the Strone chalet last week in July first two in August. Also Steve Ravenhall, two-three weeks from 28th July at the Invermoriston campsite. Your news and views are always welcome and necessary, address still:- R.R.Hepple, 7 Huntshieldsford, St Johns Chapel, Bishop Auckland, Co Durham, DL13 1RQ. Tel.(03399) 537359. Subs,U.K.£2.75. U.S.A. \$10.00.