wrong, it was simply not researched enough then. We now know that Younger Dryas sediments can be identified throughout the North Atlantic region and perhaps more widely. It can be identified with certainty in southern Italy and Florida and as a climatic event in ice cores and ocean cores. It was clearly an event of huge regional importance.

The Younger Dryas presents interesting and unanswered scientific problems. It was plainly a climatic reversal to cold, after a brief, but strong, warming at the end of the Last Glaciation. Its chronology is well established but precisely why did it happen at all? It began and ended suddenly, in decades rather than centuries, a sobering thought at times of concern for climatic change. Its deposits are found at the base of our lakes and ponds but it also caused small glaciers to form. At Lough Nahanagan in the Wicklow Gap south of Dublin the end moraine of a small corrie glacier lies under the lake's surface — it was exposed when the lake level was lowered during construction of a pumped storage scheme for electricity generation. The moraine is of Younger Dryas age. It contains blocks of organic material formed in the Late Glacial lake which were ploughed up by the developing glacier. Was there some explanation other than lack of grazing for the disappearance of the giant deer. After all, it had survived the main glaciation. How? Where? There are still problems to struggle with in the study of this fascinating time.

ITALY

In Italy we had the good fortune to find a very important lake site in the centre of the peninsula, near the town of Melfi, about 100 km east of Naples. The circumstances were that Professor Brian Huntley of the University of Durham, a post-doctoral student of mine in Dublin at the beginning of his career, and his colleague Judy Allen and I, working with a grant to me from the European Climatology Programme, were looking for a site to study in Italy. It was part of a plan, which ultimately proved over-ambitious, to make a transect of perhaps five sites in Europe from south to north for a comparative study of their forest history. Much of our field-work was unproductive until Brian and Judy returned from Italy with a 25.5m core taken from the swampy margin of Lago Grande di Monticchio (Lake Monticchio for brevity). Some lakes, of which Lake Monticchio is one, provide especially favourable environments for detailed chronological study. These are usually deep lakes without inflowing streams and protected from strong winds by natural features which permit sedimentation in calm water without disturbance. In such an environment sediments may be deposited as annual couplets in which the spring and later summer productivity of the lake are distinctive in composition and colour. In some lakes the spring/summer colour distinction is so great that the cores appear zebra-striped but, more commonly, as at Lake Monticchio, the seasons have different shades of brown. They are visible to the naked eye or can be seen in thin section under the microscope. The annual couplets (laminae, bands or varves) can be counted and can yield an exact chronology over long periods of time. Varve-counting can be demanding and time-consuming. It requires skill and dexterity in preserving and mounting the cores for study.

Lake Monticchio resulted from a very large volcanic explosion which took place about 130,000 years ago according to the opinion of Italian volcanologists, whose estimate corresponds with our independent results. It is an ideal study site with no inflowing streams and it is protected by the forested steep walls of its crater. After the original explosion created a lake basin, it filled with water, and sediment was deposited until today, when the lake is not even 10 metres deep. Cores from the lake reveal long periods of varve formation. In addition, the sediments contain numerous volcanic ash horizons which are datable by direct study of the larger ashes and by comparison with already dated volcanic deposits from elsewhere in the region. The distinctive geochemical characteristics of the ashes in the Lake Monticchio core point to the source volcano, in nearly all cases from the Naples/Vesuvius area.

I studied the first 25.5m core collected in 1983 from the marginal swamp of Lake Monticchio making use of pollen and plant macrofossil analysis. The resulting publication in 1985 was rather unsatisfactory because of dating difficulties, subsequently overcome by newer technologies and a better choice of material to date. The core clearly recorded the last 13,000 years (Postglacial/Holocene and Late-Glacial) and a long earlier record where the age was still obscure. The site was discussed at several conferences where a variety of opinions was expressed. One of the outcomes was an approach from a German group, based on the GeoForschungsZentrum (GFZ) geological research centre at Potsdam near Berlin, under the leadership of Professor Jörg Negendank and with several highly skilled younger colleagues, among whom Bernd Zolitschka was prominent in our early years of cooperation. The involvement of the GFZ was critical because it was very well equipped and experienced in taking long cores throughout the world. It was also well supported financially. The lake was cored from the surface in several expeditions to 70m and finally, in 2000, to 102.3m (about 336 feet). I participated in the work until the late nineties but had retired before the final very deep core was obtained. My contribution was to study the pollen and plant macrofossils of the first 50m and of some of the still older sediments and to study and record the species composition of the surrounding oak and beech forest which was necessary for the interpretation of the pollen counts.

For the larger cores, drilling was carried out from a large platform which had been towed to the lake centre and anchored by ropes to the shore. The lake is shallow, less than 10m deep and nearly 1km long. Cores were taken in 3m increments with a sampling tube of 10cm diameter with reduction in diameter as the bottom was approached. Driving down and lifting the coring rods was carried out with the aid of a small engine. Casing was used at the highest levels to ensure that the coring is carried out vertically in the same hole at each drive. The coring rods were screwed together and taken apart by a drilling team as the sampler was alternately lifted out and then thrust down to the next level. Coring is a heavy job physically and can use every possible mechanical aid. In the last coring effort in 2000, already mentioned, at the depth of 102.3m the rocky bottom of the basin was reached. This was a remarkable achievement for, at such great depths, the chance of equipment failure is high. One must envisage the sausage-like cores placed end to end as being longer than a full size football pitch.

The cores are dark-brown when predominately organic, which indicates a warm temperate climate at the time of deposition, and lighter-coloured with a higher inorganic component of silt and clay during cold periods. They show signs of annual banding for long periods and also layers of tephra (volcanic ash) varying from microscopic to obvious to the naked eye. There are eleven marker tephras, thick layers which can be dated. They play an essential part in establishing the chronology of the site. One, at 56,000 years old, is 30cm thick, and must have been disastrously destructive over large areas. The astonishing number of 340 tephra layers has been identified in the longest core, testimony to the persistence and frequency of volcanic eruptions in southern Italy.

We now know probably more in detail about climate and vegetation cover in the last 130,000 years in southern Italy than anywhere else in the world. Quite simply, nothing comparable is known anywhere else. It is a world-class site of great importance to climate history. It is the only site known where a complete glacial-interglacial cycle has been studied in such great detail.

In broad outline what has been established is that, after a period of extreme cold, the Last Interglacial warm period with climatic characteristics like the warm interglacial in which we live, began about 127,000 years ago and lasted for 17,000 years. The present warm period (Post-glacial or Holocene) began approximately 11,000 years ago, preceded by a brief warm/cold oscillation (ending with the Younger Dryas episode). It followed the last period of severe glacial cold which ended the complete glacial/interglacial cycle. The Last Interglacial was followed by two long near-interglacial warm phases, separated from each other by short cold episodes. The major cold phase which followed began about 83,000 years ago. It was a time of variable environments with some partially wooded periods but never fully forested, as in the warm phases, and always with some steppe or grassland. The very cold 10,000 or so years before the Late-glacial and Holocene was treeless in southern Italy with herb-rich steppe-like grasslands. The climatic information inferred from pollen and plant macrofossil analysis is placed in a very detailed time frame based on annual laminae, radio-carbon dating, tephrochronology (dating by volcanic ashes) and several other technologies[1] such as Argon/Argon ($^{40}Ar^{39}Ar$) dating. The broad characteristics of the climatic events known in detail from Lake Monticchio can readily be closely linked chronologically to comparable sequences recorded in marine cores from the North Atlantic, ice cores from Greenland and lake cores from Florida. What has been discovered is not just valid for southern Italy or western Europe, but for the whole North Atlantic region, east and west. The wider interactions with adjoining continental regions and, especially, comparison with information from ice cores from Antarctica are currently active topics of study.

NORTH AMERICA

In 1961 I received an invitation from Professor Herbert E. Wright Jr (Herb) of the University of Minnesota to spend a period of study in his laboratory, funded by the local Hill Family Foundation, and to deliver a course on biogeography to graduate students. My research was to study plant fossils, especially seeds, from peat and lake sediments in Minnesota. Herb was building up what developed into one of the leading groups of Quaternary scientists in North America, partly by inviting European scientists to work as part of his research group and to share their skills. My travel to Minnesota was funded by our own Scholarship Exchange Board. Gerry and our two little boys, Niall and Michael, came too. Our daughter Sheila was born in 1963 after we returned to

[1] Detailed references to new technologies used can be found in papers listed in the Bibiography (Braurer et al. 2007)