

FEW readers will be unfamiliar with the sight of a caver, sitting on the floor, huddled over a little aluminium box with a loop of ribbon cable to one side, with microphone held to an ear. Even those who aren't members of a rescue team will probably recognise that box of tricks as the Molefone, the mainstay of rescue communication since the 1980s. Developed by Bob Mackin of Lancaster University, the Molefone was the first practical cave radio. By permitting an underground team to talk directly to the surface, through solid rock, it is probably not overstating the case to say that the Molefone revolutionised cave rescue, both in the UK and abroad.

The race is on

HOWEVER, the Molefone was for the 1980s, by which I mean that it used electronic components of that era. Although it doesn't matter what components are inside something that continues to work, if and when it fails it is vitally important that spare parts are available. The Molefone was built like a tank and, as a result, the vast majority were still working and in regular use by the UK's rescue teams until only a few years ago. This is undoubtedly a tribute to its designer, but nothing works for ever and a spate of failures, coupled with the obsolescence of some of the parts, caused warning bells to start ringing within the British Cave Rescue Council (BCRC). The race was on to find a new rescue radio.

Meanwhile, members of the BCRA's Cave Radio & Electronics Group were experimenting with new techniques and designs of cave radios. Most notably, CREG member John Hey had designed a radio which, when used with earth antennas instead of the familiar loops, could provide communication



The HeyPhone story

by
Mike Bedford

through around 800m of rock.

A field-meet to demonstrate and discuss rescue communications, organised by the CREG in Derbyshire in March 1999, served to bring interested parties together. The BCRC and its member rescue

teams saw the new system in action in Peak Cavern and recognised that this could be the basis of a new generation of rescue radio. A project team was set up to turn the design into a practical rescue radio.

From concept to production

A LOT of blood, sweat and tears were expended in the intervening two years. Initially, there were endless discussions on the exact specification required for the new radio design and at times it looked as though a consensus would never be achieved. However, despite requirements which were often mutually exclusive, a specification was eventually drawn up which satisfied all the teams.

The ball returned to John's court to come up with a prototype which incorporated all the new features that the teams had requested, a task which he completed admirably. Pete Allwright then took centre stage, doing a grand tour of the UK to demonstrate the prototype to each of the BCRC's teams. The mechanical design was addressed next and, because no suitable enclosures were available off the shelf, Brian 'Jopo' Jopling designed a custom two-part case with the main electronics in one half and the damage-prone components such as switches and connectors in the other. This approach allows team members to carry out basic maintenance without the risk of disrupting the main electronic circuit boards.

Finally, the question of manufacture came to the fore. For obvious reasons, many of the teams were insistent that the radio was commercially manufactured; quotations were obtained and it soon became clear that this would price the radio beyond the reach of most teams. However, John Hey stepped forward once again, this time with an offer to manufacture the units himself. As a retired electronics engineer with extensive experience of manufacturing, this satisfied the quality concerns of all, but it was no mean job. A total of sixty-six radios, each containing three circuit boards, were manufactured by John – in doing so, I estimate that he made over 50,000 soldered joints.

In practice

SO how does the HeyPhone differ from the Molefone? In many ways the two radios are very similar. In fact, the HeyPhone was designed to operate on the same frequency as the Molefone to make it compatible for those teams which still have working Molefones. If both radios use loop antennas their range will be similar but, as has already been mentioned, the HeyPhone can use an earth antenna and this gives a major improvement in its range.

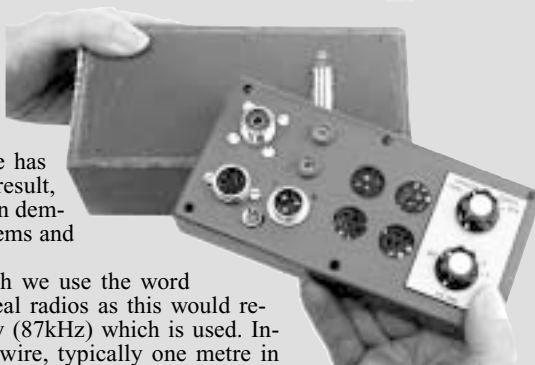
The other differences are mainly user-convenience features. For example, the HeyPhone sends a bleep when the user presses the press-to-talk button on the microphone and sends a bleep of a different duration and pitch when it is released. These start-of-transmission and end-of-transmission tones reduce the likelihood of confusion when

Loops vs. Earth Antennas

THE Molefone uses loop antennas and achieves a range, depending on the geology, of a couple of hundred metres. The HeyPhone has the option of using earth antennas and, as a result, has a much greater range – up to 800m has been demonstrated. But what are these two antenna systems and how do they work?

The first thing to point out is that although we use the word 'radio', cave communication systems aren't real radios as this would require huge antennas at the very low frequency (87kHz) which is used. Instead, a loop antenna is a multi-turn loop of wire, typically one metre in diameter, which is laid on the ground. Systems which use loops operate by induction and, if you know anything about electronics, you can think of it as a transformer with a huge separation between the primary windings (the transmitter loop) and secondary windings (the receiver loop). Induction is, inherently, a very short-range phenomenon, but it is able to cover the distance normally needed for cave to surface communications.

An earth antenna consists of two lengths of wire, each up to 25m long, running away from the radio and connected to the ground at the far ends. This allows an electrical current to be injected into the ground through a pair of widely separated electrodes – it operates via a combination of effects including conduction and induction. An earth antenna can be thought of as a huge, single-turn vertical loop through a slice of the earth. The much greater diameter of this loop compared with a conventional one-metre loop helps explain the greater range which is achieved.



The HeyPhone is built in two parts. The lower box is waterproof and contains the sensitive electronics, while all sockets and controls are held in a separate box connected by a single cable – an easier system to maintain than a single box would permit

The Nicola System

THE Nicola System was developed in France following a tragic incident in the Gouffre Berger in 1996 in which two people were killed. Named after one of those casualties, Nicola Dollimore, the system has been issued to French cave rescue teams and sets are also given to parties in the Berger to provide early warning of possible threats such as heavy rain.

The Nicola System is similar in many respects to the HeyPhone – it operates by low frequency induction and can use earth antennas – and has provided communication over a distance of more than a kilometre of rock. In fact, the Nicola System was demonstrated by part of the team which developed it – Jean-Jacques Fauchez, Paul Mackrill and Graham Naylor – at the meeting in Derbyshire when the HeyPhone project was launched. At one time the idea of replacing Molefones with the Nicola System was discussed by the BCRC but, as that design was already set in concrete, the decision was made to develop a system tailored specifically to the needs of UK rescue teams.

the radios are being used by inexperienced operators. The HeyPhone also has a speaker so that the operator doesn't have to continuously hold an earpiece to his or her head, allowing the radio operator to help with other aspects of the rescue without missing radio traffic from the surface. A secrecy mode, in which the speaker is disabled, is available for passing sensitive information such as the condition of a casualty.

Perversely, the foot-and-mouth epidemic has proved to be one of the greatest contributors to cave safety for

years; as I write this, in mid-August, most of those sixty-six HeyPhones are sitting, unused, in rescue stores around the UK. With very few people caving, even fewer need rescuing and, except for an incident in February in Daren Cilau, the HeyPhones haven't yet been used in anger.

However, as and when access to our caves is fully restored, we have every confidence that the HeyPhone will serve a new generation of rescuers every bit as well as the Molefone did for the previous generation.



More information

THE HeyPhone design has been placed in the public domain. If you want to know more, look at CREG's website (www.bcra.org.uk/creg) or contact the group via Rob Gill at creg@bcra.org.uk or 61 Cross Deep Gardens, Twickenham, Middlesex TW1 4QZ (enclose an SAE).



The HeyPhone packed into a Pelicase

John Hey (left) receiving his award – an inscribed glass plaque in recognition of his services – from Bill Whitehouse, BCRC Chairman, on 1 April 2001. It was on this occasion that John was told that the BCRC had decided to call their new radio the HeyPhone. Photos: Mike Bedford

FACING PAGE: Brian Judson in Carlswork Cavern