In January 2000 I took my CED micro1401 on a trip to the bottom of the world. I was taking part in a training and research course run by the American National Science Foundation to investigate "Integrative Biology and Adaptations of Antarctic Marine Organisms" at McMurdo Station in Antarctica. This annual course enables participants to learn first hand about a wide range of Antarctic biology, and to carry out research using the outstanding facilities at McMurdo. I took the opportunity to initiate a research program that will analyse the effects of temperature on neuronal function of marine invertebrates, one of which is a large Antarctic isopod that is distantly related to woodlice (Figure 2). The small size and low weight of the micro1401 and its recently developed USB interface for my laptop computer were crucial in keeping my load of equipment below the strict weight limits imposed on us for the flight 4000km south from New Zealand.

I was busy packing up for the winter shut-down. The main thrust of research in my laboratory is to understand how nervous systems of insects carry out computations that allow them to make precisely directed limb movements. In fact, I am more used to working with desert locusts than with weird marine creatures! So what is the connection with Antarctica? My interest comes from the observation that although physiological processes slow down dramatically as temperature falls, Antarctic marine invertebrates such as the giant isopod, Glyptonotus antarcticus, still manage to get around rather rapidly, find food and presumably avoid predators, all at -1.8°C. I want to determine what mechanisms permit their nervous systems to operate quickly enough to drive these complex behaviours. A second general question is to ask if these animals, which have evolved in an extremely stable thermal environment for millions of years, can adapt to changes in temperature. By comparing neuronal function in Antarctic isopods with that of their relatives from the coast of England (which experience wide fluctuations in temperature), I hope to determine how nervous systems maintain their precise patterns of activity as the rates of underlying physiological processes undergo marked changes.

I have used CED equipment for over 10 years, but it was only with the development of this research project that I had to start thinking about removing my micro1401 from its comfortable home in my lab setup. The first step was to test under the somewhat harsher conditions of a damp 7°C cold-room here in Cambridge, where I was happy to find that the equipment performed perfectly. The second step was to put together a portable setup that could be transported to the Antarctic and used in a relatively confined space.

At that time the USB interface was in a late prototype stage, so I was fortunate to have the help of Tim Bergel of CED in updating my micro1401 and checking that it would all work with my laptop. We had to be certain that nothing would go wrong because there would be no chance of carrying out anything but the simplest of repairs once I landed on the ice. In the course of these trips we were often face to face with the local Adelie penguins and Weddell seals, and on most days we saw Minke and Killer Whales.

Back in the lab things were somewhat more routine, and with 24 hour daylight, we spent a lot of time working! I set out to test neuronal conduction velocities in leg nerves of the large isopod Glyptonotus, which were collected by scuba divers from the seafloor. I put together a temperature-control setup using coils of copper tubing, foam packing and lots of duct tape (Figure 1) and set about making recordings. The micro1401 and laptop running Spike 2 formed the core of my equipment, serving as a recorder, display and analysis system. In terms of data processing, I barely scratched the surface of the capabilities on hand, simply measuring latencies and mean waveforms of the neuronal signals recorded from the leg nerves. The new USB interface worked without a hitch. Given the time, weight, and lab space restrictions, simplicity of experimental design was a key factor, and in the end every experiment yielded valuable data, which we are now using for comparative studies here in Cambridge. One of the first results from this is the clear demonstration that neuronal conduction velocities in the Antarctic isopod are affected less by changes in temperature than are those of other invertebrates previously studied (Figure 3). We have subsequently discovered that the European isopod Ligia also has low thermal sensitivity so we have a lot more work to do. My PhD student John Young will continue these analyses over the next three years.

Tom Matheson’s homepage: http://www.zoo.cam.ac.uk/zoostaff/matheson/index.htm
Antarctic Course: http://www.rcf.usc.edu/~dtmlab/biocourse2000

Fig 1. Carrying out experiments in the Crary Lab at McMurdo Station.

Fig 2. An Antarctic isopod Glyptonotus antarcticus on a pair of cold hands.

Fig 3. Neuronal function of both Antarctic and European isopods has a low temperature sensitivity when compared to that of other invertebrates. Ligia data courtesy J. Young.