The World's Deepest Hole

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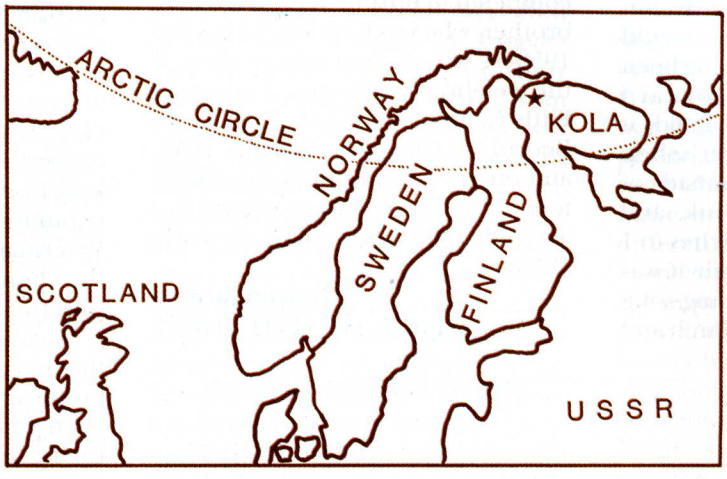
LESLEY and I stood in the buffet queue at the Academy of Science Hotel, Moscow. We were now on our own - no Russian guide, no Con to help us. I leafed through the phrase book, silently practising some essential phrases - some meat, two tomatoes please, and so on. A young man ahead of us was trying to order an omelette in sign language; I asked whether he was English (I meant to say, did he *speak* English). A familiar accent responded to this implicit insult, "No, I'm from Glasgow".

It was Colin McInnes, a research student from our very own *alma mater*. He was in Moscow to discuss putting into orbit a solar sail satellite with the Soviet Space Agency. He had flown out a few days previously, on 19 August the day of the coup, just as a Scottish tabloid newspaper featured on its front page the story of a Scot "bribing a taxi driver ... dashing to the airport to escape". Clearly the onward progress of international science is not to be impeded by minor details like counter-revolutions.

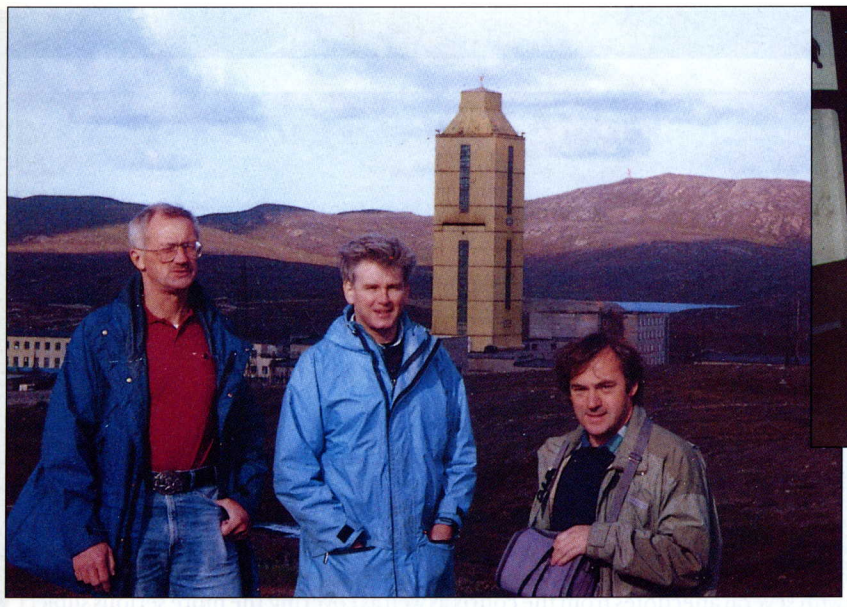
Lesley Dickie and I were headed for the Kola Peninsula in Arctic Russia, to see the world's deepest hole into the Earth. I was to finalise details of a multinational geophysical project to take place there early next year. Lesley, a Zoology undergraduate, had made a scale model of the huge drilling rig. The model sits on a ledge in a stairwell of the Geology & Applied Geology department, and its 12 kilometre long drill pipe is represented by a wire hanging down to the basement floor, three floors below. It gives a vivid impression of the scale of this feat of engineering. It was completed just in time to impress (we hope!) the Secretary of State for Scotland, Ian Lang, whom the Principal had invited to visit the University last June. One of my Russian colleagues, the Director of the Kola Science Centre, had also been so impressed by it that he had asked Lesley to make him another model and bring it to Kola to install in his institute, all expenses paid.

In Murmansk we met Con Gillen, who had arrived from Edinburgh *via* a geological conference in Finland. Con is another Glasgow graduate like myself, but graduating one year ahead in 1969. Not only did he get a first class Honours degree in Geology, but he speaks no less that 14 languages! He went on to do a PhD, also at Glasgow, and has been visiting the Baltic region, including the Kola Peninsula, for many years. Only through his invaluable contacts and command of Russian (his first love among foreign languages) has our international project got off the ground. We also met Scott Smithson, Professor of Geophysics at the University of Wyoming, who is in charge of the US contribution to the project. The fourth member of the partnership, aside from Scotland (and, of course, the Russians) is Norway, represented by Bergen University.



Finally, after three years of planning, we arrived at the location of our geophysical experiments, the SG-3 drill site, just three miles from the Norwegian border. It is near the ore-mining and smelting town of Zapolyarny, one of the major sources of pollution within the Arctic circle. The hole was begun as a scientific quest, over 20 years ago, to find the source of the mineralising fluids that give rise to the rich copper-nickel deposits of the Kola region. Coring all the way down - collecting end-to-end cylindrical samples of the rock being bored, rather than just grinding through it - is a slow process, but the Russians have amassed new and unique information about the nature of the Earth's crust. At 12,261 metres into

Glasgow scientists Colin, Lesley and Dave in Moscow just after the coup of August 1991, wearing their new Russian Republic badges.



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a. Scott Smithson, Dave Smythe and Con Gillen at the Kola superdeep hole. The 90 metre high tower houses the drilling rig.
b. Lesley with baby woolly mammoth, St Petersburg.

the crystalline rock of the ancient baltic shield, it is more than twice as deep as any other such hole in the world. They had reached this depth by 1984, but it is surprisingly difficult to keep a borehole vertical. It had deviated so much from the vertical that further drilling had become impossible, and the drillers had to backtrack to 8,000 metres depth and start afresh - hence the hiatus. The new branch hole is vertical, and they now confidently plan to push on to 15,000 metres, reaching this depth in another three or four years.

What the region lacks geologically, despite its unique mineral wealth and "superdeep" borehole, is an acoustic cross-section through the crust, to give a picture of the layering as if the crust were sliced open like a piece of cake. The technology, called seismic reflection imaging, is a form of echo-sounding through miles of solid rock, and has many similarities to medical body-scanning. It is the technique used by the oil industry to find likely geological reservoirs of oil and gas. The combined teams of geophysicists from the Universities of Glasgow, Wyoming and Bergen, have the equipment and computers to do the job; this is an area of expertise where, in contrast to deep drilling, the Russians are behind rather than ahead.

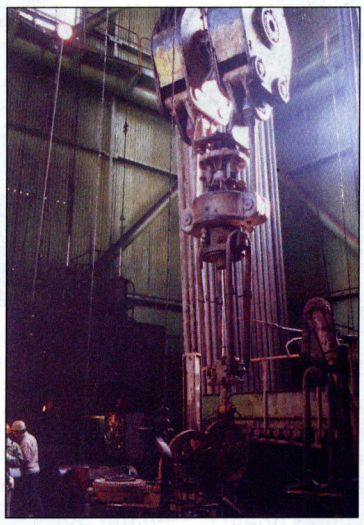
We shall be driving four vibrator trucks in from Norway to create a sound source for the echoes. These huge beasts lift almost their entire 24 tons weight off the ground, and vibrate in unison the base plates upon which they rest. This sends a continuous shock-wave into the ground, from which sharp crisp echoes can be discerned after some clever computer processing. This method is environmentally more friendly than using dynamite to create a sudden pulse. About 10,000 microphones planted in a line in the snow and ice will record the faint echoes, which end up being displayed in pictorial form as a quasi-geological cross-section. We are confident of getting echoes from at least as deep as the Moho - the base of the continental crust - which is about 40 kilometres deep in the Baltic region. The combination of a seismic cross-section of the crust, which has now been done in many parts of the world, with the borehole, which is unique, will give us a new understanding of the nature and origin of the crust generally.

The short Arctic summer turns the tundra to mosquito-plagued bog. Our Russian colleagues, who specialise in seismic "expeditions", as they are appropriately called, tell us that the only time to do the experiment is in late winter, when the ground and the lakes will be frozen. Minus 30°C, they tell us, is *"ne problema"*! We shall see, once we arrive next February for the ten week long field campaign.

The planning of the experiments finished, our hosts took us to another region where foreigners need special passes. The eastern Kola Peninsula is a complete contrast to the despoiled western area, for here the Arctic forest is almost undamaged by humankind. We camped for a night on the shores of the White Sea, at a mineral collecting locality famous for its amethysts. Much of the eastern peninsula now has the status of national park, and the Russians plan to exploit its beauty in a benign way by encouraging "scientific tourism". Groups of overseas scientists, including amateur collectors and enthusiasts, will be able to come and work, collect specimens, and so on, and in so doing will bring in some sorely needed "currency". The Russians don't bother to preface this word by "hard", as they do not seem to regard roubles as real money any more.

Back in Leningrad, we visited the superb Zoological Museum, where woolly mammoths dug out of the Siberian permafrost are on display. They are 10,000 years old; geologically speaking, that's only a few minutes, although I have to admit that fossils don't usually come with fur on. A few days later we left what was now St Petersburg, the old name having been revived during our stay.

The Glasgow-Kola link will be long-term, and we can already see beyond the confines of geology and geophysics, to future joint research in marine biology and zoology.



Inside the drilling tower. The lifting gear takes the 180 ton weight of a 12 km long drill string.