

**A scientific visit
by**

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**to the
Pavlov Institute, Leningrad, USSR
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Arrival

Driving down Upper Wharfedale one cold morning in January 1973, at least six people stopped me to say "Your visa's come for Russia!" The postman, unable to get to my house for the snowdrifts, had left the message along the valley. After four months of assorted delays, I was on my way.

The first problem had been that the laboratory at which I was to work said that they were not ready to receive me. That news arrived about six weeks before I was due to depart in September 1972. The laboratory wanted to delay the trip until January 1973. As I was not on sabbatical, but actually finishing my job at The Open University (a fixed term contract) at the end of September, this could have caused great difficulties. Fortunately The Open University was able to find money for a further three months.

When the revised time for my departure approached, a new problem arose. The Soviet Embassy in London would only issue a visa when presented with official authorization, which meant a letter on Academy of Sciences notepaper, and a signature. A cable was not sufficient. The Academy in Moscow apparently insisted that the authorization had been given to the Embassy to issue the visa, and that was that. In the meantime, I retired to the Yorkshire Dales to allow the left and right hands to coordinate.

It was early February 1972 before I was actually on board the boat train. The three-day journey was uneventful, but not dull. The changing scenery, with-ever-deepening snow, the conversations with African students of the Patrice Lumumba University, practising my still primitive Russian, provided interest enough. The carriages were of an old-fashioned solidity that I was soon to become familiar with. Each carriage had its own central heating, from a stove at the end of the corridor. Ours smelt as if it ran on peat, which it quite possibly did.

The Russian customs officials seemed interested in very little except my collection of tape cassettes, and played a few seconds of each on my portable recorder. They could have got little appreciation from the music, as the battery was almost flat. At Moscow, I donned my goatskin coat and fur hat, sure I was to catch a chill from the emergence from the overheated carriage into the depths of a Moscow winter. To my surprise it felt warmer than Yorkshire. It was. It was 4°C that day, and the winter in Leningrad I believe never went below -10°C. At the station I was met by representatives of the British Embassy and of the Soviet Academy of Sciences, the latter enquiring why my trip had been delayed...

Although I was not to spend the night in Moscow, I was taken to the Academy Hotel. This was greatly appreciated, for after three days in a train, a bath was most welcome. That night at midnight I took the famed 'Red Arrow' to Leningrad. The Moscow-Leningrad run is one of the fast lines of Europe, aided much by being flat and straight. The 'Aurora' during the day takes just five hours to cover the 650 km, as fast as the electric Scots. But the night sleeper is run slower, to take a full eight hours so that you get a comfortable ride and a good night's sleep. (British Rail please note!). In the morning I was met by Leonid

Pevzner with whom I was to work, and taken to the Hotel Oktyabrskaya. Things were beginning to run smoothly. (It was not to last!)

The Pavlov Institute

The I.P. Pavlov Institute of Physiology is not in Leningrad itself but in a village called Kolteshi, about 25 km from the city centre. A group of low timber framed buildings dating from Pavlov's original establishment house some of the laboratories, while others are in more modern buildings, and there are shops and flats. It is all set in a rather neglected park, with a lake, and many fine old trees. The clear whiteness of the snow was in pleasant contrast to the slush in the city. Many mornings were bright and clear and crisp, with the trees outlined with rime, and the sun glinting from the ice crystals floating in the air. In the summer children swam in the lake, and made crowns from the abundant dandelions, while goats and cows were tethered to graze (goats eat dandelions very gracefully, clipping off the flower tops one by one, leaving the bitter stalks behind).

The Laboratory of Functional Neurochemistry is in one of the old buildings which was in fact built as a hotel for visiting scientists. (It would have had about eight bedrooms.) The head of the laboratory is Professor N.N. Doemin, who is concerned mainly with biochemical correlates of sleep and sleep deprivation. He is a very friendly man, very cultured and well travelled, with a very good sense of history as well as of science. Leonid Pevzner works on the differences between neurones and glia (the two main cell types in the nervous system) and on the way these two cell types react to changes in the environment of the animal (stress, drug treatment, motor, exercise, etc). The equipment is limited, but adequate to the task in hand, the main item being the microspectrophotometer, a device for measuring the absorption of light by very small areas of a microscopic section of tissue.

Other large items of equipment are available in other laboratories in the Institute. I visited several of the other laboratories, in particular Biochemistry, Neurophysiology, and Psychology. In the Neurophysiology Laboratories I was shown work on the interactions between arousal and pituitary-hypothalamic activation (which is involved in the stress response) (Ref. 1). I also saw some of the work being done on chimp behaviour. They demonstrated a number of tasks involving transfer of learning from one modality to another – for instance, chimps taught to make a tactile size discrimination are rapidly able to transfer that ability to a visual size discrimination. This visit was at the time when my parents visited Leningrad, and Leonid Pevzner was kind enough to give them a tour of the Institute which interested them greatly, including the small museum they have to Pavlov with his office. But it was the chimps who provided an entirely unplanned welcome.

Kohler (Ref. 2) writes of chimps building piles of boxes, in order to reach a piece of fruit hanging from the ceiling:

Mutual obstruction is more frequent than cooperation. Tercera and Konsul do not take part in the building operations; they sit on some point of vantage, and watch the others at work. But when the building is in full swing they give striking proof of their comprehension. They love to creep up behind the back of the busy architect, especially when he is perched precariously high and, with one vigorous push, knock both building and constructor to the ground. They then flee at top speed. Konsul was a master at this game, as well as of every grotesque contortion. With an expression of comic rage, stamping, rolling his eyes, and gesticulating, he prepared his fell design behind the innocent constructor. It is impossible to describe happenings of this sort. I have seen observers shed tears of helpless mirth as they watched them.

'Boy' was bored in between tasks and occupied himself in throwing pieces of orange peel at me. Thinking it was a game I threw one back at him. He responded with a temper tantrum, which ended with his trying to pee at me. But he was too far away and wandered off in a sulk. But he had not forgotten his grudge, for about ten minutes later, from the top of the cage, he tried again. He missed me. Unfortunately, perhaps, for he got my mother sitting next to me.

The work

I had been concerned for several years with the problems of changes in the biochemical processes in the central nervous system that could be correlated with behaviour, or with various kinds of environmental stimulation in an experimental animal. A number of workers had shown increases in rate of synthesis of protein or ribonucleic acid in animals exposed to a learning situation. However, in any learning situation there are other factors that will differ between an experimental animal and the control (an animal not exposed to the learning situation), for example motor activity, stress arousal. I had shown that in a rat subjected to forced exercise in a motor-driven wheel (Ref. 3) there was a decrease in incorporation of radioactive-labelled amino acid into proteins of cerebral cortex in vivo. Incorporation of label into proteins can, with certain precautions, be used as a measure of rate of protein synthesis. This result suggests that stress or arousal cannot explain the learning effects. But there remains the question of the further analysis of the effect of forced exercise, which is interesting in its own right.

At the Pavlov Institute and elsewhere related work had been going on using forced swimming as the exercise situation (Refs. 4, 5 and 6). This is a much more stressful situation, and involves a greater degree of exertion than exercise in a motor-driven wheel. So it was not at all clear whether the results from the two types of experiment could be directly compared. At the Pavlov Institute the work had involved not measurements of incorporation rate, but changes in nucleic acid content in the cells, measured cytospectrophotometrically. The cytospectrophotometer is a type of microscope that allows one to pass a narrow beam of light (typically 2 urn diameter) through a stained and mounted slice of tissue. In the case of nucleic acids, the stain used is chrome-gallocyanin (Ref. 7). The absorption of light

by the section, combined with determination of the cell size, gives a measure of the quantity of nucleic acids in an individual cell nucleus and cytoplasm. The DNA is almost entirely confined to the nucleus and is unlikely to change significantly in amount during the experimental period (one hour in this case). So any changes in nucleic acids may be attributed to RNA. RNA in the nucleus is largely newly synthesised messenger, while cytoplasmic RNA is mainly ribosomal. Both types are of course necessary for protein synthesis, so measures of changes in nuclear and cytoplasmic RNA will reveal changes in different aspects of the protein synthetic capacity of the cell.

Brumberg (Ref. 4) of the Pavlov Institute had shown increases in RNA of motoneurons of the spinal cord but not in the surrounding glia after hours of forced swimming. Our intention in Leningrad was to draw these two lines of work together by measuring the RNA content of cerebral cortex and spinal cord motoneurons, and of their surrounding glia, after forced exercise in the motor-driven wheel.

My first tasks were to give a specification for a wheel to the workshop, and to learn to use the cytospectrophotometer. The wheel was made within ten days, familiarity with the measuring equipment took a little longer. After that I settled down to work, which was carried out in collaboration with Leonid Pevzner and Tanya Glushchenko.

The results of the investigation have been published in Doklady Akademia Nauk (Ref. 8). They indicate that the processes going on in this rather mild activity situation are similar to those in the forced swimming situation. There is an increase in RNA content in both nucleus and cytoplasm of the motoneurons, with smaller or no changes in the glia. This result at first sight seemed puzzling, in the light of the decrease in incorporation into cerebral cortex protein referred to above. However, later work (Ref. 9) has shown that when the neurones and glia of cerebral cortex are separated by centrifugation after *in vivo* incorporation, the effect of forced exercise is not the same in the two cell types. The glia show a decrease in incorporation, but the neuronal cell bodies show an increase. Thus there seem to be two different processes going on in different compartments of the central nervous system. (1) An increase in neuronal protein synthesis, correlated with an increase in RNA, i.e. with the protein synthetic capacity of the cell. (2) A decrease in glial protein synthesis, not correlated with a concomitant decrease in RNA levels, and therefore presumably occurring by a different mechanism. This picture complements a number of other studies in which reciprocal changes have been shown to occur between neurones and glia.

Other Visits

I had asked on my original proposal to visit the laboratory of Dr Olga Vinogradova in Pushchino-na-Oka, who was doing some very elegant neurophysiological work. Her studies on conscious freely-moving animals complement the behavioural work of Sokolov on the orienting reflex. I planned to visit her in April. Having written to her to make sure that she would be there at that time, I made this suggestion to

the Academy office – well in advance. I was advised to leave the trip until June or July. When this time approached, I again raised the subject, to be told ‘You must realize that this is a very difficult time for visits. Everyone is on vacation’. As indeed she was.

I also wanted to visit Dr Kometiani in Tbilisi, and Dr Buniatian in Yerevan. I had not put this down originally in the programme, but raised it with Mr Smoryakov who was dealing with me in the Academy office (a very helpful man, incidentally). He advised me that it was possible, provided that the Royal Society agreed. As Mr Deverill of the Royal Society was scheduled to arrive shortly, I left it until then, when he discussed the matter, which I thought agreed. One day in May I went to the Academy office, Mr Smoryakov was not there. Enquiries revealed that he had been transferred to Moscow at two or three days’ notice. His successor, of course, knew nothing of any arrangements that were not on my original programme, and as mail takes about three weeks to and from the Soviet Union, it was too late to arrange anything. So I made no scientific visits outside Leningrad, to my great disappointment.

General

I was paid 220 roubles a month, about £130 at the official rate. My accommodation in the hotel was paid for. The rouble in terms of buying power is of course worth considerably less than the official rate (although the black market rate rather undervalues it if taken over a range of goods). A few things are cheaper than in England – books and records for example, and bread and a few other basic foodstuffs. Most other basic things though are 1 – 2 times more expensive than in England (though perhaps comparable to continental Europe), while luxuries tend to come expensive unless bought for convertible currency. Thus a single person is able to live without difficulty, but I would not want to try to support a family with no other income than that.

The quality and more especially the variety of goods is limited (except for bread, which is excellent in both respects!). But comparing notes with people who were in the Soviet Union a few years ago, both are steadily improving. But stock-keeping still seems an unknown art. People buy things when they are available, and the furnishing of the homes I saw seemed infinitely better than one would imagine possible from looking around the shops. By the same token, if you want a particular book or record (or even a particular size of battery!) you are likely to have difficulty, but browsing around the shops can reveal many interesting things. I was particularly interested in the second hand bookshops, and in one selling books from the Socialist countries.

Concerts are frequent, and good, and also very well attended, which often means booking well in advance (Intourist does not bother with people who want to pay in roubles). I saw delightful puppet shows, and of course the ballet, and while in Moscow the circus, with its famous clown, who stole the show with juggling and tightrope acts that were often better than the main acts, themselves well done. There do not seem to be cultural barriers that exist in Western Europe, or at least not to the same

extent. Young friends I made who played Led Zeppelin or Rolling Stones, seemed equally at home in a classical concert, and this seemed to be the rule rather than the exception.

Eating and drinking were at times a problem. I was in a hotel all the time. (Incidentally I discovered towards the end of my stay that the Academy has an apartment, which was empty. They thought I would prefer a hotel....) Thus I had no cooking facilities. So when I did not want to buy cheese or ham, etc. I had to eat out. And in the cheaper places one might have to wait for half an hour to get in. The bars were worse. The only places where one could just walk in and get a drink were the hotel bars, which take 'currency' only (i.e. convertible currency). As I was being paid in roubles, this did not help much. As far as the shops were concerned, vodka was always available, but beer and to some extent wine are in very erratic supply. The common beer (Zhigulevskoe) is terrible, but there are a few reasonable ones (in even shorter supply of course), and I even found a stout, called, logically enough, 'porter'.

There are of course many things to see in Leningrad. Many are described in the tourist literature, and are none the worse for that. One sees the golden spire at Petropavlovsk in the postcards. But below the walls of the fortress is a beach where you can swim in the Neva. (Imagine swimming in the Thames by Waterloo Bridge!) In fact, while the river is frozen they cut a swimming pool in the ice for hardy souls who come out in bathing trunks, slippers and gloves, and clear the morning's ice off with a net before taking a dip. After the thaw, when the Neva has been clear of ice for some days, Lake Ladoga in its turn thaws, and the river is again full of ice floes jostling their way to the Baltic. And in June, during the white nights, the embankments fill with youngsters, often in small groups around a guitarist, to watch the sunset turn to sunrise and the bridges lift to let the oil and gas tankers through from the Black Sea.

Departure

From Leningrad I was to continue east, to attend the meeting of the International Society for Neurochemistry in Tokyo in September. Because this was a business trip I was able to buy a ticket for the trans-Siberian express for roubles at the same price as a Russian would pay, rather than buying a package deal from Intourist for 'currency'. One of the world's last great bargains, the trip to Khabarovsk cost just over 70 roubles (about £40) for 5000 miles! A train journey of seven days takes on a new dimension. Not so much a journey, more a way of life. Hoffnung's advice 'on entering a railway compartment, be sure to shake hands with all the occupants' ceases to be a joke. I met some interesting people on this trip also. The pace is of course leisurely, the average speed being rather under 40 m.p.h. Stops at stations allow time to buy marinated mushrooms, hot buttered potatoes and other delicacies from peasant ladies, while unscheduled stops might see half the occupants of the train picking large juicy blueberries from beside the track.

The Great Russian Plain is exactly that, while beyond the Urals, the scenery does not really become interesting until Irkutsk. The line goes to the south of Lake Baikal, where before a route was blasted around the steep mountains, which in places drop sheer into three thousand feet of water, a British-built ice-breaker used to ferry the train across the lake, summer and winter. Further east, and fewer and fewer signs of people, with perhaps twenty miles between stations serving villages of a few hundred inhabitants. Part of the way along the eastern section we were pulled by steam and finally reached the bridge across the Amur, nearly two miles long, leading into Khabarovsk, about 25 miles from the Chinese border. We were one hour late, after 184.

Khabarovsk is a small industrial town, not used to tourists staying any length of time. The woods near the town are splendid, while the river is muddy and fast flowing but not at all polluted, in spite of being downstream of oil installations. One realised the scale of distances, seeing the radio dish that picks up the TV programmes from Moscow via satellite. We are in fact nearer to America than Europe. I spent several agreeable days in Khabarovsk before flying to Niigata in Japan.

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