Baikal-Amur railway

Building too fast for efficiency

SOVIET plans to complete construction of the Baikal-Amur Mainline (BAM) railway by autumn 1984, a year ahead of schedule, have been jeopardized by a lack of understanding of the geology of permafrost. This year, the Soviet media have noted several instances where the rapid exploitation of geological research findings for the good of the economy, urged by successive five-year plans, has run into difficulties. Oil extraction from newly discovered fields in Siberia is far behind schedule, and it was revealed last month that the reservoir of the Cheboksary hydro-electric station on the Volga had caused an unexpected rise in the water-table between Cheboksary and Gor'kii, so that the water-table in Gor'kii has already risen to ground-floor level in some places.

Such problems seem endemic in a centrally planned system. Civil engineering works may be started without allowing sufficient time for preliminary surveys; and if one sector carries out a programme of "shock-work", others working at normal speed will appear to be lagging.

The trouble on BAM appears to be a result of the decision to bring forward the construction date, so that the last "golden link" could be laid to celebrate Revolution Day (7 November) this year. BAM, which has been hailed as one of the most important achievements of Soviet civil engineering, has been built in sections, and the running of trains on completed portions has already earned, its publicists claim, impressive sums from the Soviet economy. Looping far to the north of the (Tsarist-built) Trans-Siberian Railway, and thereby avoiding sensitive areas close to the Chinese border, BAM, when completed, is expected to offer fast and competitive freight rates for the container transport of goods from the Far East to Western Europe. The driving of the final link is therefore economically important.

The course of BAM was carefully planned — according to official reports — by a think-tank covering all the relevant scientific disciplines. The chief snag on the final choice of route was the Kodar range of mountains, through which a 2-km tunnel had to be drilled at an altitude of 3,000 m. When the completion date was brought forward, it became necessary to complete this tunnel by May 1984 (leaving six months for the track-layers to do their work), and the tunnellers forged ahead with such gusto that by 15 February, they had already excavated 1,600 m of tunnel.

Unfortunately, however, the concrete workers responsible for facing the newly dug surfaces made slower progress, and before they could catch up, lumps of rock began breaking away from the unfaced ceiling of the tunnel. It was eventually decided to reinforce the roof with metal structures, but this remedy was adopted

too late to prevent a serious cave-in.

Serious recriminations have broken out as to who was responsible for the cave-in. The tunnellers blame everything on the "mysteries" of the permafrost. They have hinted, moreover, that the strata encountered were less hard than the geologists had supposed, and that although temperatures were monitored in the excavated tunnel, readings were taken only at floor level, and it was only later discovered that temperatures near the roof were considerably higher (around 12°C). The chief directorate for the BAM construction, however, tends to blame "sluggishness" in

the concreting of the roof, while admitting that an elementary law of physics had been ignored — that at the temperatures that built up in the tunnel, permafrost gradually ceases to be permanent.

All the resources of Soviet society have now been mobilized: representatives of the Party bureau have been posted to "key sectors" and the concreting teams reinforced with Party cadres. The Ministry of Transport Construction has instructed the tunnellers to have the tunnel ready for traffic this autumn. The Chief Tunnel Construction Directorate, according to the Soviet newspaper *Sovetskaya Rossiya* considers this task "unrealistic". Officially, however, the schedule for driving the golden link remains unchanged.

Vera Rich

Optical microscopes

Reflector makes high price

A RARE reflecting microscope constructed in 1827 by John Cuthbert under the guidance of Dr Goring, the eminent Scottish microscopist, was sold last week in Sotheby's London sale-room for £8,000, about three times the price expected. The instrument was based on one produced several years earlier by the famous Italian experimenter Giovanni Amici, but instead of varying the magnification by a set of eyepieces, Cuthbert has provided a series of elliptical mirrors and Lieberkuhns. The mirrors are mounted in tubes to which the Lieberkuhns can be attached.

The reflecting microscope first made its appearance when the struggle for the achromatization of the microscope had almost been abandoned. Great strides had been made in the mechanical properties but there had been scarcely any improvement in the optical performance of the microscope since its invention two hundred years earlier.

Isaac Newton had certainly not helped matters by supporting the view that the construction of a colour-correcting achromatic lens system was not possible, and in 1672 he wrote to the secretary of the Royal Society outlining his ideas on how chromatic aberration could be overcome in a microscope by the use of a "reflecting piece of metal instead of an object glass".

Newton's preoccupation with a reflecting rather than with a lens system was influenced by his conclusion that refraction is always accompanied by dispersion, an unfortunate conclusion which went unquestioned for many years and which resulted in considerable delay before serious research was undertaken on the achromatic lens. As to Newton's microscope, if he ever had plans for its construction, they appear not to have materialized.

The first satisfactory reflecting microscopes made their appearance some 50 years later, and were by the Italian and London makers, Amici and Cuthbert.

John Quekett, in his microscope treatise of 1848, points out the difficulties of making and using these instruments, but of the Cuthbert microscope, he says that it was (in its time) "the most perfect instrument manufactured in this country".

The success of Cuthbert's microscope was, however, short-lived. In 1830, just three years after its appearance, a development took place which struck a death-blow

The Cuthbert reflecting microscope

to all reflecting microscopes: the successful production of the long-awaited achromatic objective. For the first time, the conventional compound microscope began to emerge as an indispensable tool in science and industry. No longer was it merely a plaything for dilettante enthusiasts, who, to quote a nineteenth century historian, "regarded their costly instruments as precious toys rather than as tools for work and study".

Paradoxically the twentieth century has seen the re-emergence of reflecting systems for specialized use in ultraviolet or infrared regions of the spectrum; so even if Newton had been misled in his dispersion experiments, his pioneering work on the reflecting microscope was not altogether in vain.

Arthur Frank