with non-specific bacteria helping to sustain a low oxygen regime. An organism which combines the first two activities in one cell could have practical advantages, a point which, according to Waterbury and colleagues has not escaped the attention of 'genetic engineers'. To construct a nitrogen-fixing cellulolytic bacterium by genetic manipulation ought not to be diffi-

cult, but this particular race seems to have been won by the microbial ecologists! □

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History of science

Scientific instruments and history

from David W. Hughes

THE abundance of excellent papers presented at the Third Scientific Instrument Symposium* made it plain that scientists should think much more positively about the museum potentiality of their old instruments and about keeping careful documentation of their instruments' lives.

Between the laboratory and the museum there looms a gap of about 50 years — a chasm which is difficult to bridge. We should all try to make the road to the museum easier. In many schools, colleges, universities and laboratories, where science was, and still is, taught and research prospers, there is probably a dusty cupboard hiding a treasure store of scientific instruments that would gladden the heart and mind of many a scientific historian. Think twice before throwing old instruments away!

Speakers at the symposium came from museums all over Europe and took many different approaches to the subject. One approach was to look at the work of particular individuals. G. Hartl (Deutsches Museum, Munich) introduced G.F. Brander (1713-1783), one of the most important scientific instrument makers in Germany during the eighteenth century. Brander could produce glass scales on which the millimeter was divided into 30 equal parts; a considerable advance in the accuracy of measurement was thus generated. By 1780 the catalogue of Brander's workshop included 102 instruments covering the main areas of contemporary natural science: astronomy, mathematics, optics, meteorology, geodesy and physics. Brander's work was on show at the museum; a superb exhibition of the instruments from the workshop has been assembled by a team of Deutsches Museum scientists under the leadership of Alto Brachner and will stay on display there for the foreseeable future.

Another Munich personality was Joseph von Fraunhofer (1787-1826). It was through Fraunhofer's work that the scientific and industrial basis for the production of pure, defect free optical glass and its manufacture into lenses, achromatic lens

combinations and prisms was created. The desire for a more accurate determination of the refractive indices of these glasses led to the discovery of the dark lines in the solar spectrum that bear his name. The small glass works at the Monastery of Benediktbeuern where Fraunhofer manufactured glass between 1807 and 1819 still exists.

The teaching aspects of scientific instrumentation were emphasised by A.D. Morrison-Low (Royal Scottish Museum, Edinburgh), who has investigated how J.H. Bennett introduced microscopy into the teaching curriculum for medicine at the University of Edinburgh in 1841. The work of Bennett and his colleagues helped transform the microscope from a scientific toy into a first-rate research instrument.

Scientific apparatus can also be studied by concentrating on a specific task. R.G.W. Anderson (Science Museum, London) took distillation as his example, stimulated by the Science Museum's recent acquisition of some important tenth to twelfth century chemical glassware of Islamic origin. He has been able to trace the development of alembics and retorts, cucurbits and receivers.

Not surprisingly, museums featured strongly at the Symposium. G. Fodera Serio discussed a museum that may be opened at the Palermo Astronomical Observatory, Sicily. In 1790 Guiseppe Piazzi, the first director, equipped the observatory with the most up-to-date instruments he could get. Many were

obtained from the famous London instrument maker Jesse Ramsden, the two largest being a five-foot alt-azimuth circle and a transit instrument. These have been lovingly restored and provide a beautiful 'snapshot' of an observatory of that time. Another new display was described by Hemming Anderson (Soro Akademi, Denmark). For the last 80 years the physical instruments collected by Adam Wilhelm Hauch have been stored away in packing cases. The instruments of French, English, Dutch and Danish manufacture are now restored to view. A unique discovery was described by A. Brachner (Deutsches Museum). In December 1982 he was contacted by the Benedictine Monastery of Ochsenhausen, Bavaria and asked for advice about the conservation of an astronomical instrument. On going to the monastery he found their baroque observatory dome contained a beautiful example of a late 18th century, three-metre radius, azimuthal quadrant that had probably been used for teaching purposes.

Scientific expeditions are a potential source of information for the historian of scientific instruments. In 1878 the Dutch Schooner *Willem Barents* sailed to the Spitsbergen and Barents Seas. Systematic scientific observations, concentrating on cartography, maritime meteorology, physical oceanography, and terrestrial magnetism, were carried out. W.F.J. Mörzer-Bruyns (Maritime Museum, Amsterdam) has been able to reconstruct the inventory of instruments used on board the ship.

Thomas Graham wrote in 1838 'It is curious how much the progress of science depends upon the invention and improvement of instruments.' It is obvious from the Symposium that the study of old scientific instruments and methods is in capable hands. Many modern scientists would be fascinated by the genealogy of their instruments and can play an important role in saving our scientific heritage by helping instruments find their way to museums. □

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100 years ago

ON Monday, September 24, about 9 p.m., a remarkable phenomenon occurred at Käringsön, in the province of Bohus, Sweden. During a perfect calm a violent whirlwind suddenly arose from the south-east, carrying with it a quantity of sand, earth, and straw, when suddenly a bright light lit up every object and made the night as clear as day. This was caused by a magnificent meteor, egg-shaped in form, which appeared in the zenith, and which at first seemed to consist of myriads of large sparks, gradually changing into a star shining with a blinding lustre, and which burst, with all the colours of the rainbow, in the north-west, four to five metres above the horizon. When the meteor had disappeared the wind suddenly fell, and it was again perfectly calm. The phenomenon lasted

about sixty seconds. The wind had throughout the day been south and very slight.

A sharp shock of earthquake was felt at Bermuda on October 20, but no damage was done. A shock was felt at Tashkend at twenty minutes past two on the morning of the 27th, accompanied by loud subterranean ramblings. A despatch from Smyrna dated October 28 reports that the wall surrounding the town, the Aqueduct, and the Hadji Hussein Mosque have been damaged by an earthquake. The minaret and dome of the Hadji Ali Mosque at Capan Vourla have also been injured. At the last-named town one hundred and sixty-nine persons have been seriously, and sixty-one slightly, hurt. Seventy-nine wounded people are in the hospitals.

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*The Third Scientific Instrument Symposium of the Scientific Instrument Commission of the International Union of the History and Philosophy of Science was held at the Deutsches Museum, Munich, September 26-October 1, 1983.