Telescopes of the future: heading for the supergiants

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Optical and Infrared Telescopes for the 1990s. Edited by Adelaide Hewitt. Two volumes, pp.1260. (Kitt Peak Observatory: Tucson, Arizona, 1980.) \$35 + \$15 airmail.

AT a time when the financial outlook for fundamental science may appear bleak, these two volumes should raise the spirits even of the pessimistic. Undaunted, more than 200 scientists and engineers gathered at Tucson, Arizona, in January 1980 to discuss how best to apply the latest technologies to the design and construction of very large optical and infrared telescopes, and what further technological research and development is needed for that purpose in the immediate future. This record of their deliberations makes exciting reading.

A wide range of possibilities was considered for telescopes with apertures mostly in the range 7m to 30m; the pros and cons of monolithic versus segmented mirrors, multi-mirror versus multi-telescope, single telescope versus arrays, were argued. Everyone, it seems, accepts that mirrors will be thin whatever configurations are adopted; the UK Infrared Telescope has proved that they can give optical performance and major cost savings.

Although various kinds of mountings were mentioned — alt-az, inverted alt-az, siderostat, steerable dish — not a lot of consideration was given to this aspect of telescope construction, and even less to the problems of domes and buildings. These are areas where major cost savings may be made and it could be worthwhile having a follow-up conference on the topic of housing very large telescopes. A radical breakaway from historical approaches (even recent ones such as the MMT building and the CERGA concept) may be possible and desirable if large economies are to be made, sufficient to make the construction of very large telescopes acceptable propositions. Do we really need to erect large concrete towers with rotating domes on top, or even rotating buildings, to protect the telescope from the weather and to provide a satisfactory working environment for engineers when it is not being used, and to shield it from the wind when it is? The cost is high not only in financial terms but in the deleterious effect which the building usually has on the astronomical seeing. I think that far more satisfactory structures could be made at costs one to two orders of magnitude less than those current.

A heartening feature of the discussions, however, was the recognition of the need to pay attention to the relationship between the design and aperture of the telescope, and the effects of the atmosphere on the image. These are of course functions of the

wavelengths at which the telescope is to be used and therefore relate to the astronomical research objectives and to the instrumentation — spectrometers and detectors — to be employed. This chain forms a recurring theme throughout the discussions; repeated attention was drawn to astronomical objectives and to the need to make the whole telescope system efficient. Considerable further advances in computer control are possible and substantial gains in efficiency can result from more extensive use of photoelectric autoguiders. It is surprising, as one participant pointed out, that autoguiders are still so little used. Every telescope built by the Royal Observatory Edinburgh since 1962 has been autoguided and that has been a major factor in the high quality of photographs produced by the UK Schmidt Telescope in Australia which was equipped with one from the outset; if it can be done for a Schmidt telescope, it can be done for any telescope.

There were so many contributions that it is impossible to mention more than a few. The experimental data on deformable mirrors by J.W. Hardy I found fascinating; also the discussion of (iso)thermally invariant structures by F.D. Drake and the paper on imaging by C.H. Townes. The most important technological papers, however, were probably those concerned with the matter stated succinctly by T.S. Mast and J.E. Nelson:

The central problem with a segmented mirror is to assemble the small mirrors and maintain their orientations and positions so they form the figure of a single large optical quality mirror.

Between the sheets

J.M. Thomas

Intercalated Layered Materials. Edited by F. A. Levy. Pp.562. (Reidel: 1979.) Dfl.150, \$78.

WHEN a sheet-like structure assimilates guest species into its interlamellar spaces the phenomenon is known as intercalation. The uptake of ammonia by clay minerals in soil, first identified in 1850, is an example of such a process, so also is the swelling of clay when immersed in water, an effect known to the potters and ceramicists of antiquity. When transition-metal chalcogenides (such as niobium diselenide or molybdenum disulphide) take up alkali metals, the intercalation may dramatically alter the electronic properties of the parent solid: semiconductors become metals and metals semiconductors, purely as a con-

A telescope of today: the multi-mirror telescope on Mount Hopkins, Arizona.

Much effort, study and experiment will be devoted to this problem in many observatories around the world during this decade. It will be a happily competitive business, a race to be the first with the biggest and the best. It is difficult not to believe that the problem will be solved and the 1990s will see giant telescopes with apertures of 25m or more probing the outer half, the earlier half, of the Universe, intent upon discovering its structure, chemistry and evolution. The prizes in new knowledge in one of the most fundamental of our sciences could be immense, a just and proper reward for the supergiant telescope builders.

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sequence of the donation of electrons into empty or partially filled bands. Moreover, the addition of a wide range of organic materials (amines, amides, acids, pyrimidines and numerous heterocyclics and their derivatives) changes the superconducting transition temperature of the chalcogenide. When graphite, the best known and most widely studied of layered solids, assimilates certain electron-donating or electron-accepting guests, the process is accompanied by many significant structural, chemical and electronic changes. Alchemists would doubtless have been aroused to discover that when graphite is exposed to the vapour of potassium the glistening black solid is "transmuted" into a specular, golden mass. Intercalated species generally carry a residual charge and they usually take up