thin mirror construction, polishing of fast (that is highly curved) primaries, computer aided design and control, and the alt-azimuth concept with its favourable affects on dome size, will enormously decrease the costs of future telescopes per metre of aperture. A 2-metre for less than $2.5m complete is now a certainty and proposals for a 14-metre at the price of a conventional 4-metre are being discussed in detail.

With falling costs, single institutions may be able to contemplate a big telescope for themselves. The University of Texas is considering a thin mirror (20 cm) 7-metre monolith for less than 25 million dollars; the University of California, a segmented 10-metre mirror for somewhat more. Domes can prove expensive items in the budget: at 2 million dollars the rotating asymetric dome of the 3.6-metre equivalent Multi-Mirror Telescope, now in use on Mt Hopkins, is probably a realistic pointer towards the future.

The high cost of the conventional telescope springs largely from the mass needed to maintain optical rigidity. Very large telescopes must depart from this philosophy and rely instead on the active interrelation of light thin structures. The reflecting area will either be segmented or divided into a number of separate mirrors aimed at a common focus: lasers may be used for active alignment of the components (a scheme already being tested on the Multi-Mirror Telescope) although simpler, computer-based, electro-magnetic linkages between segments now look quite adequate.

The dome costs, which are considerable, rise at something like the cube of the telescope length, so there is much more pressure to construct primary mirrors as fast as F/1.75 instead of the customary F/3. Such a trend will also help to shrink the starfield onto miniature modern detectors such as CCD's, but useful angular field of view will then also shrink due to aberrations. While opticians are now confident they can devise these fast mirrors using computer-controlled polishing machines, astronomers are uneasy at the loss in field of view. It is true that big telescopes are largely used for on-axis spectroscopy, in which field-size is unimportant. However, at the conference J.R.P. Angell (Steward Observatory) demonstrated the dramatic changes we can expect from optical-fibre techniques. He used fibres for the simultaneous conduction of light from 16 widely spaced cluster galaxies down the slit of his spectrograph; thus once again highlighting the usefulness of a wide field. The battle between the big-fielders and little-fielders has scarcely begun.

The alternative to a single large instrument of revolutionary design is an array of smaller ones, adding either their light or their post-detector signal. The problems of long horizontal light beams and multiple reflections probably make a light adding design suitable only for interferometry. Any array of small instruments must reduce unit costs to the point where a very large area can be operated at a reasonable price. To reach the goal of 25 m for around $150m the choice is either a fully instrumented 2-metre unit at $1m, or a 4-metre at $4m. The Kitt Peak proposal for an Advanced Technology Telescope of 2 metre size incorporates fast thin-mirror automatic setting and guiding for a projected cost around $1.7m. How far 'mass' production could bring this down further is still uncertain. In France, A. Labeyrie (CERGA, Grasse) is operating the first of his concrete, onion-shaped 1.5-metres, which, due to their weight do not need a dome and can cost a mere $120,000 per square metre of collecting area.

With infra-red astronomy making great strides it will obviously be sensible if infra-red and optical astronomers can contrive to share telescopes. There was much debate on this issue, but with no clear result, mainly because infra-red astronomers see the need for at least two different kinds of instrument. There seems to be no doubt that the diameter of the image is disturbed by atmospheric 'seeing' as a function of wavelength, following a $\lambda^{-1/5}$ law as predicted by the theory of homogenous turbulence. Given a telescope of sufficient diameter to be diffraction limited, the atmosphere will allow 0.5 arc second seeing at 10 microns.

This, combined with the long awaited infra-red imaging CCD's, calls for a single aperture telescope of 10-metres or more, whose structure does not radiate significantly into the beam. On the other hand, C. Townes (Bell Laboratories) and F. Low (University of Arizona) have demonstrated phase coherence at the same wavelengths for periods of up to an hour and want coherent arrays of smaller telescopes. It would seem that infra-red astronomy will now develop along the lines of radio astronomy with a request for both phased arrays and big single dishes.

The issues and questions raised by the conference come at an appropriate time. It does now seem likely that a 25-metre equivalent mirror can be built in any one of a variety of ingenious ways. It remains to be seen which is best and cheapest but astronomers will need to unite behind a single proposal before they approach governments for a sum that is likely to be nearer two than one hundred million dollars.

100 years ago

ON THE SKIN-FURROWS OF THE HAND

A large number of prints have been taken by me from the fingers of people in Japan, and I am at present collecting others from different nationalities.

My method of observation was at first simply to examine fingers closely, to sketch the general trend of the curves as accurately as possible, recording nationality, sex, colour of eyes and hair, and securing a specimen of the latter. I passed from this to "nature-printing," as ferns are often copied.

A common slate or smooth board of any kind, or a sheet of tin, spread over very thinly and evenly with printer's ink, is all that is required. The parts of which impressions are desired are pressed down steadily and softly, and then are transferred to slightly damp paper. I have succeeed in making very delicate impressions on glass. They are somewhat faint indeed, but would be useful for demonstrations, as details are very well shown, even down to the minute pores. By using different colours of ink useful comparisons could be made of two patterns by superposition. These might be shown by magic lantern. I have had prepared a number of outline hands with blank forms for entering such particulars of each case as many be wanted, and attach a specimen of hair for microscopic examination. Each finger-tip may best be done singly, and people are uncommonly willing to submit to the process. A little *hot* water and soap remove the ink.

When bloody finger-marks or impressions on clay, glass, &c., exist, they may lead to the scientific indentification of criminals. Already I have had experience in two such cases, and found useful evidence from these marks. In one case greasy finger-marks revealed who had been drinking some rectified spirit. The pattern was unique, and fortunately I had previously obtained a copy of it. They agreed with microscopic fidelity. In another case sooty finger-marks of a person climbing a white wall were of great use as negative evidence. Other cases might occur in medico-legal investigations, as when the hands only of some mutilated victim were found. If previously known they would be much more precise in value than the standard *mole* of the penny novelists.

I have heard, since coming to these general conclusions by original and patient experiment, that the Chinese criminals from early times have been made to give the impressions of their fingers, just as we make ours yield their photographs. I have not yet, however, succeeded in getting any precise or authenticated facts on that point. That the Egyptians caused their criminals to seal their confessions with their thumb-nails, just as the Japanese do now, a recent discovery proves. This is however quite a different matter, and it is curious to observe that in our country servant-girls used to stamp their sealed letters in the same way. There can be no doubt as to be advantage of having, besides their photographs, a nature-copy of the for-ever-unchangeable finger-furrows of important criminals. It need not surprise us to find that the Chinese have been before us in this as in other matters. I shall be glad to find that it is really so, as it would only serve to confirm the utility of the method, and the facts which may thus have been accumulated would be a rich anthropological mine for patient observers.

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From *Nature* **22**, 28 October, 605, 1880.

0028-0836/80/430680-02$01.00