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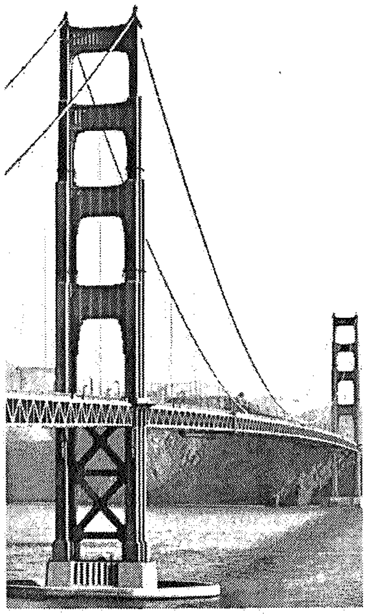
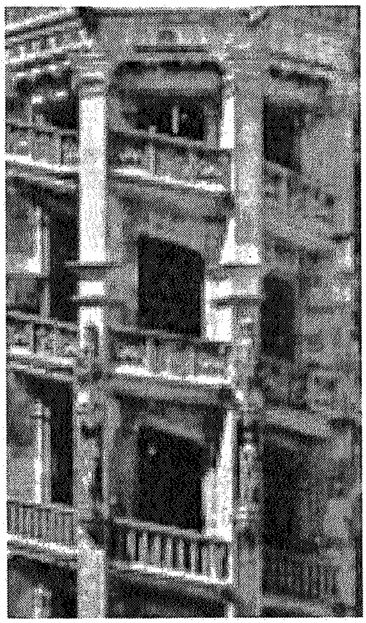
Title	The Place of Matematics
Author(s)	Peter Brinkworth & Paul Scott
ISBN/ISSN	978-1-875900-26-8
Published by	AAMT Inc.

POST GPO Box 1729 Adelaide SA 5001
PHONE 08 8363 0288
FAX 08 8362 9288
EMAIL office@aamt.edu.au
INTERNET www.aamt.edu.au





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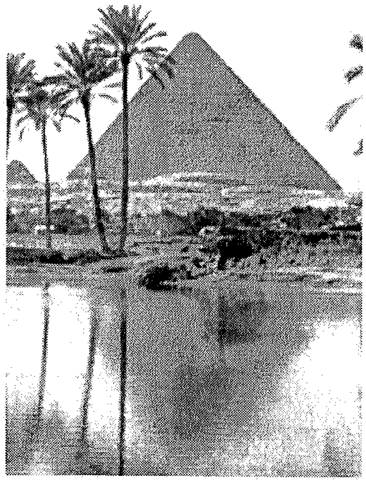
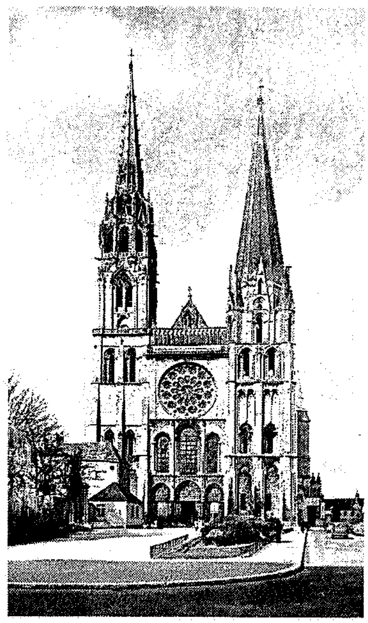
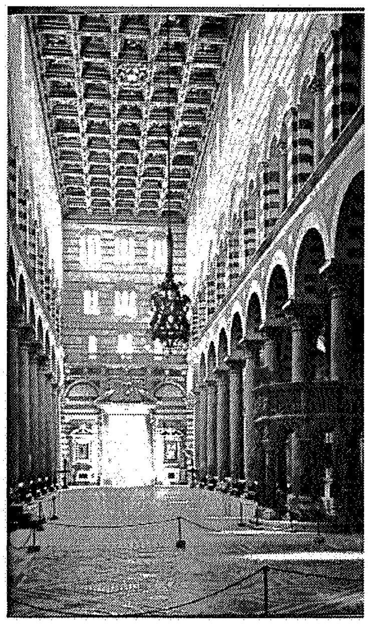






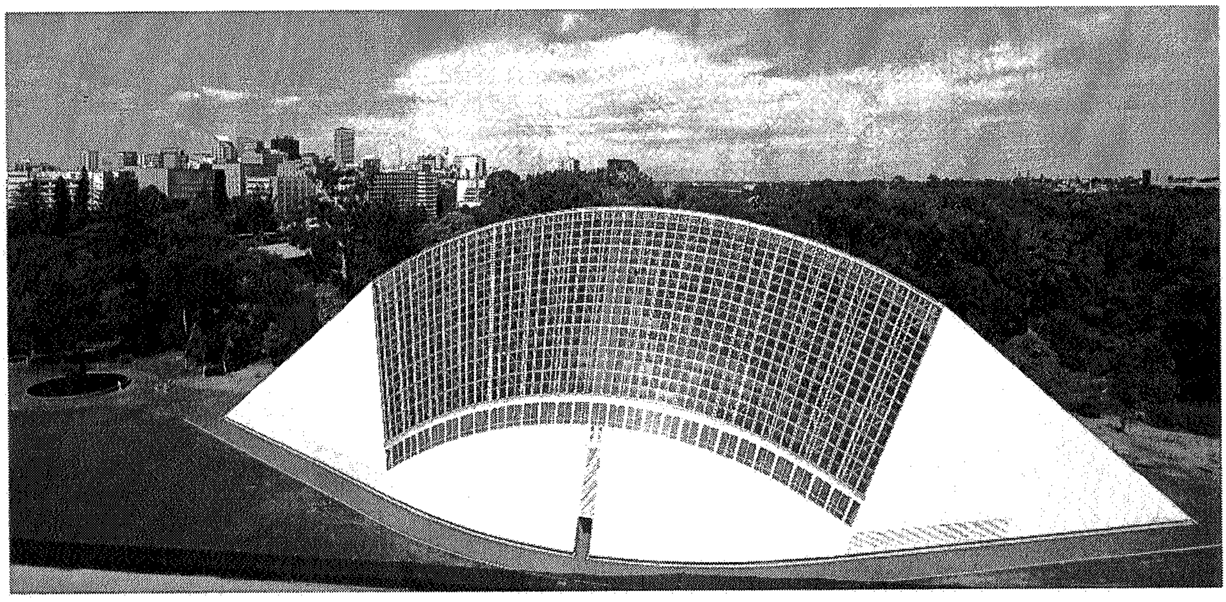
Adelaide's Bicentennial Conservatory

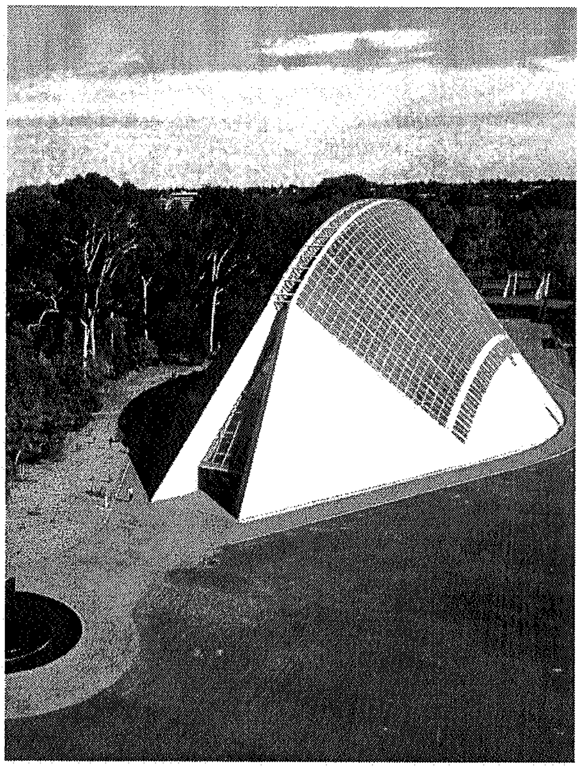
The city

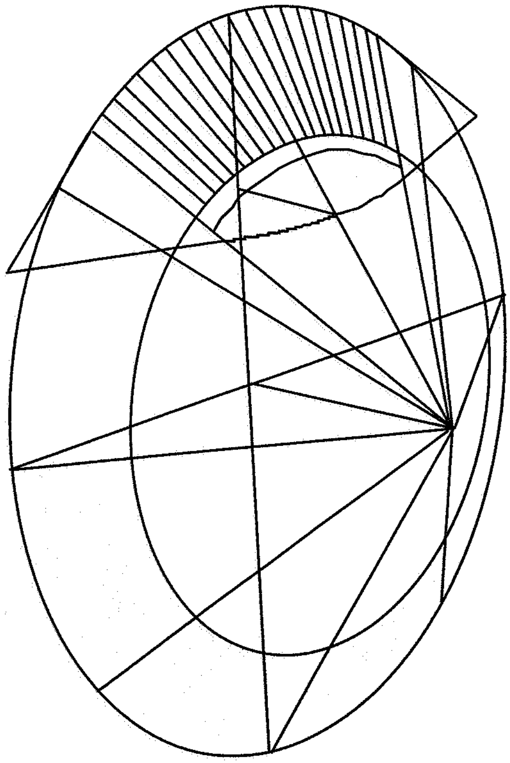
Adelaide, South Australia, is a city of a million people stretching north and south along a coastal plain bounded by the sea in the west and a range of hills in the east. The city site was chosen by Colonel William Light in 1836, and the city was named after Queen Adelaide, wife of King William IV. Adelaide is sometimes known as 'the city of churches', but it could equally well be called 'the city of parks and gardens'. The central business district is surrounded by a belt of parklands. In the northeast corner of the parklands lie the botanical gardens, and in particular the Bicentennial Conservatory, built in 1988 as one of South Australia's major contributions to the Australian Bicentennial celebrations.

The conservatory

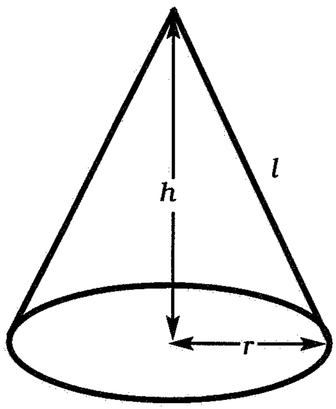
The conservatory, designed by architect Guy Maron, is of particular mathematical interest because the design is based on two identical cones having a common (vertical) base. This design feature leads not only to a striking structure, but also to economies of construction, since the curvature of the surface of the cone is constant. The surface is splayed at the ends to allow access to the conservatory.







Properties of the cone

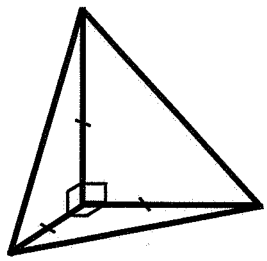


The volume V of a cone having base radius r and height h is given by the formula $V = \frac{1}{3}\pi r^2 h$.

This formula is proved most easily using calculus, but it is an example of the more general formula for the volume of a pyramid:

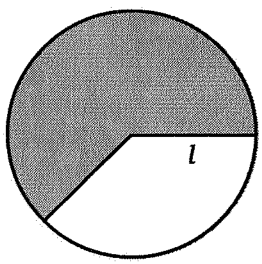
$$V = \tfrac{1}{3} \times \text{area of base} \times \text{height}.$$

1. Check the above formula for the right-angled triangular pyramid (tetrahedron) shown, by showing that three such pyramids can be assembled to form a triangular prism. (This is a good model-making exercise!) How does this assembly establish the formula?



The area of the curved surface of a cone is rather easier to find. For if we lay the surface out flat, we obtain a sector of a circle of radius l (like the shaded region illustrated below right).

2. What is the area of the whole circle? What is the perimeter of the circle? What is the length of the curved boundary of the shaded region? (*Hint:* Look at the original cone.) What proportion of the circle is shaded?



We see that the area A of the curved surface of a cone of slant height l and base radius r is

$$A = \frac{2\pi r}{2\pi l} \times \pi l^2 = \pi r l.$$