

## ACOUSTICS OF CEREMONIAL HALLS

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Ceremonial hall as a descriptor deserves some definition. Functionally, it calls to mind a large civic room where village hall has grown up to urban aggrandisement. Both Barron (1) and Forsyth (2) have written excellent accounts of the increase in scale of music performances. The heyday was the nineteenth century and there are still many examples in existence. Certain extremes are lost to us: the opening programme at the Crystal Palace featured 1,700 vocalists, band, and orchestra. Mid Victorian concerts were immensely popular as entertainment: the 1882 Handel Festival had an audience of 87,769, 500 instruments, and 4000 choir. Romantic music, with its visionary scale and dreamlike character, suited more reverberant interiors. Further strong influences included the published designs of Karl Schinkel whose Singakademie marked the rebirth of the temple from the spirit of the symphony.

Town halls featured such halls, sometimes with a secondary concert room of differing geometry. Many had huge organs, often set in semicircular, semi-domed apses with steep tiering piled around. Some 20<sup>th</sup> century examples can be argued, from Stockport Town Hall's barrel vaulted interior, to rooms within the 1928 Stormont Parliament building and the 1956 Shirley Hall in Canterbury. An outrageous unbuilt triumphal ceremonial hall was Hitler's 200m diameter Berlin Great Hall. Principally, though, there is no modern equivalent: stadia and arenas are the large-scale event foci but are functionally commercial rather than public institutions instilling civic pride. Older university buildings and public schools sport large-scale spaces that double as examination halls and degree-day settings.

The lack of modern versions is unlike concert halls where there is a longer continuity of design, and where some of the finest and most grandiose examples are recent, deservedly celebrated over a number of Institute conferences. The Lottery has resulted in many projects of community benefit, but large-scale examples like the Dome or the Glasgow Science Centre feature a strong overall form, within which a series of component attractions are placed.

Acoustically, the individual abandoned quality of reception for the rousing feeling he or she was part of the communal experience. The halls paralleled cathedrals with secular rather than religious bias stressed by frequent use of classical precedents, St George's Hall, Liverpool, for example, being based on the Roman baths at Caracalla. They were a contrast to the hundred music halls designed by the redoubtable Frank Matcham, where faces lined the walls. Ceremonial halls were not moulded to seating, viewlines, and circulation, but were imposing backdrops of remote hard surfaces.

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Geometry and spatial enrichment were typical and often produced uneven and idiosyncratic listening conditions. Domes and barrel vaults drop too much reflected sound in some seating areas, starving others. Double cube space with organs in prominent display included arcades and serried columns to further clutter viewlines and created coupled volumes 'speaking' back into the main space, in the style of Romanesque basilicas long before. A liking for circular geometry was manifested in elliptical plan shapes, semicircular bays, and barrel vaults.

### **GREAT HALL, ST. MARY'S GATE, DERBY**

The hall forms part of Derbyshire Magistrates Courts in Derby, having two Victorian courts attached. It dates from 1659 and has lost part of its glazing. Stone walls and stone-flagged floor are relieved by an added gallery to one side. Its original use was as a large meeting room.

### **PRICHARD-JONES HALL, BANGOR**

The hall is part of the Grade 1 listed University of Bangor and will be at the core of a new Welsh Music Institute. It was built in the 1900s in a collegiate Tudor with Arts and Crafts influences. It is used for orchestral recitals, music society concerts, degree day ceremonies, examinations, academic conferences, and union meetings. A small and remote gallery is set behind 25 seat rows on the flat. A dominant barrel vault and long reverberation times contribute to poor conditions for speech and uneven music sound quality.

### **SHIRLEY HALL, CANTERBURY**

This is the main assembly hall to the King's School, Canterbury, famed for its music and choral links to the Cathedral. The design is an anachronism and although post-dating the Prichard-Jones hall by fifty years, has similar distant gallery seating and shallow barrel vaulting with only shallow coffering to diffuse sound reflections around the curved profile. It will form part of a performing arts complex to be built at the School.

### **THE VICTORIA HALL, TOWN HALL, LEEDS**

The town hall housed courts and civic spaces including the colonnaded central hall of 20,000 cubic metres with its substantial organ and gallery added in 1895. The hall is popular for events, but there is criticism of its acoustics after every triennial piano competition. A major scheme (over £20m) included rebuilding the ceiling with the barrel form made acoustically more transparent. It was refused funding and there is in progress a modest (£2m) scheme to improve matters for the next contest in September 2000. This comprises raised tiering to the gallery and new seating throughout, acoustic banners, new sidewall boxes, and improved platform and 'promenader' seating.

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## THE GREAT HALL, ST GEORGE'S HALL, LIVERPOOL

Elmes's masterpiece St George's Hall is undergoing phased improvements to its cavernous 28,000 m<sup>3</sup> Great Hall and elliptical Concert Room, which seats 600. The arrangement is unusual in having the stage at the opposite end to the organ with both ends abutting courts. The barrel-vaulted ceiling spans 25.3m and the hall's volume and RT exceeds that of King's College, Cambridge (T500-1000 5.6 seconds). This example is one of the most reverberant interiors and like large-volume spaces like cathedrals, has a steep downward RT gradient at low and high frequencies. It has side galleries with very limited viewlines and coffered barrel vaulting similar to Victoria Hall. The original ventilation was a copy of Dr Reid's system at the Houses of Parliament: basement steam engine powering heat coils warming hypocaust airways which allowed convected air up distribution shafts. Besides organ recitals and civic receptions, it has to cope with meetings, dinner dances, and spectator sports.

## ROYAL ALBERT HALL, LONDON

The hall 'erected for the advancement of the Arts and Sciences' showed a significant double echo initially tempered by a cloth velarium and later diffusers array. We took detailed baseline measurements at 14 locations around the hall early in the £58m scheme in progress, since which gallery and stalls tiering and seating have been renewed. An earlier paper (3) has described the outcome of using a 1:12 physical model. Its 86,650 cubic metres and occupancy exceeding 5,000 means even major orchestral works do not provide a strong sound to all seats. However, the hall is a well-loved institution, including for the annual 'Prom' concerts, and many will call it to mind as the most prominent ceremonial venue.

## ACOUSTIC MODELLING

Each of the projects has been modelled using primarily ODEON, with baseline existing model characteristics validated to measurements around the halls' interiors. The number of internal measurement positions varied from 5 to 14 per hall, with reverberation times taken either from pistol shot recordings or MLSSA. An earlier paper (4) looked at the difficulties in modelling reverberant halls.

## IMPROVEMENT OPTIONS

The measurements show similarities of acoustic character, even for the wide scale differences between the halls. Schemes to make ceremonial halls workable venues for modern needs, address typical issues as follows:

- Increased seating rakes
- Modern chairs
- Reduced reverberance and control of sound reflections off geometric features
- Introduction of mechanical ventilation
- Introduction of high-quality directional speech reinforcement systems
- Remodelled platforms
- Introduction of orchestral canopy in order to, say, assist in cutting sound directed up to barrel vaulting.

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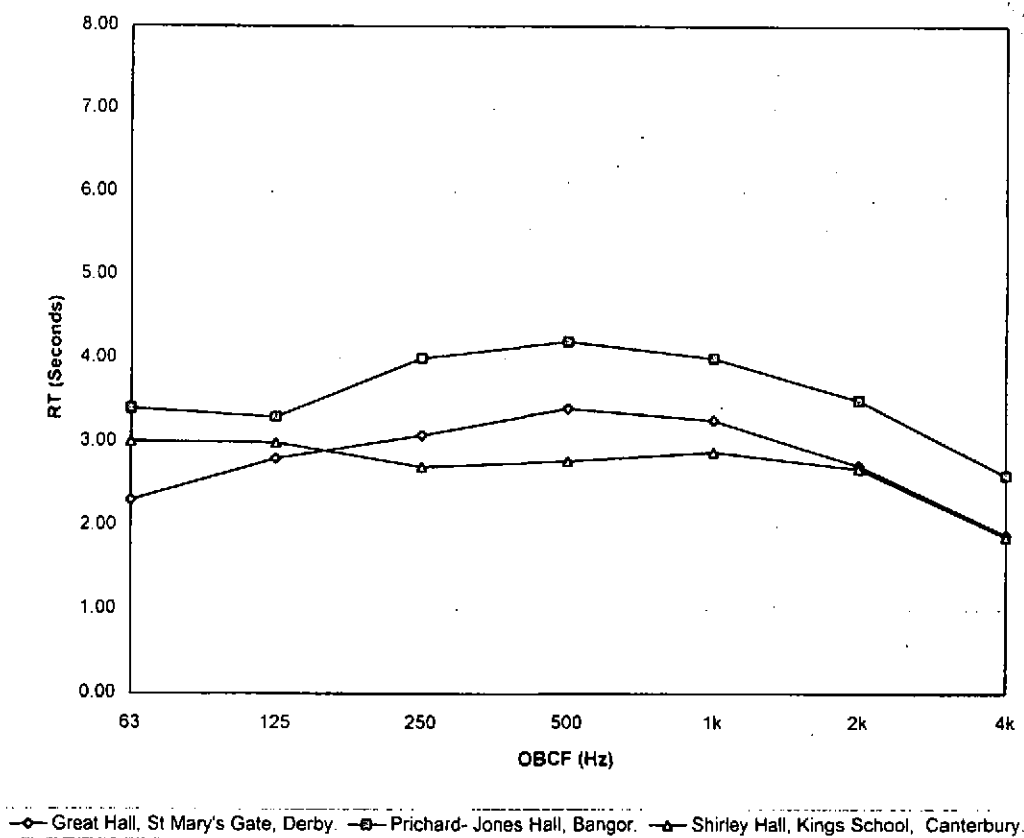
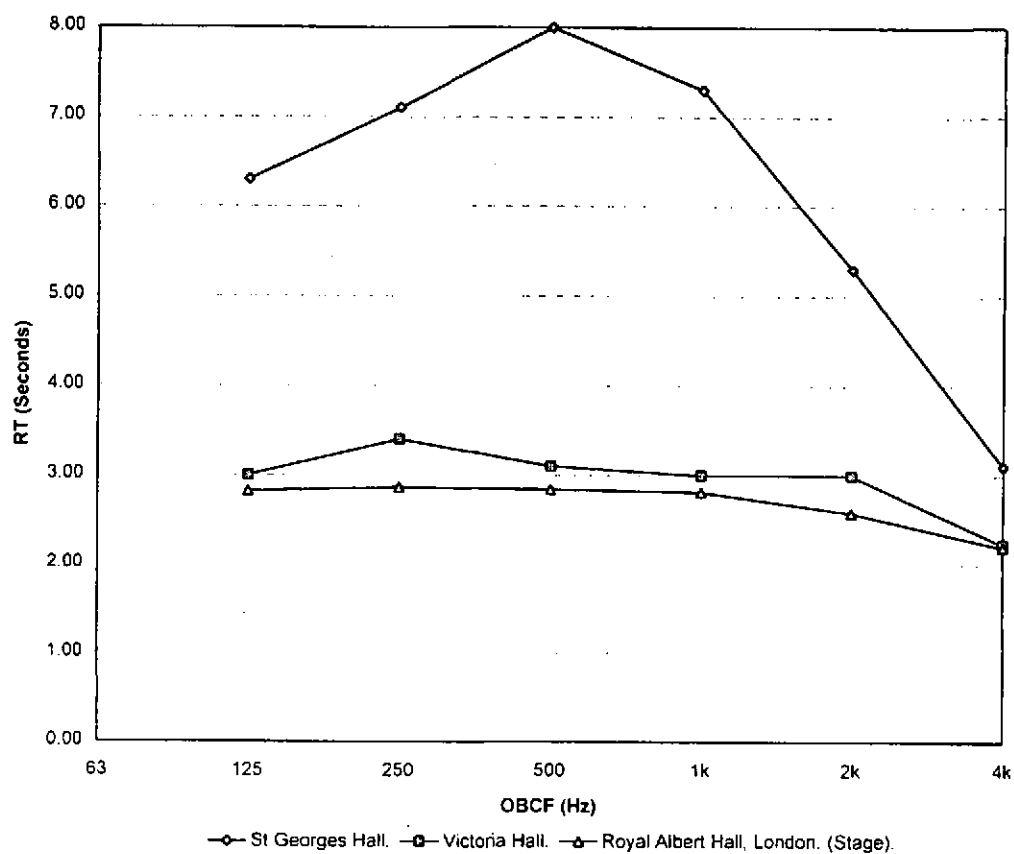
## REFERENCES

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2. Forsyth, M, *Buildings for Music*, Cambridge University Press, 1985.
3. Metkemeijer, R A, *The Royal Albert Hall, Past, Present, and Future*, pp57-66, Proc.IOA, Vol.19 Part3, 1997.
4. Templeton, D W, *The Application of Auditoria Modelling to Some Projects*, pp505-508, Proc.IOA Vol.16 Part2, 1994.

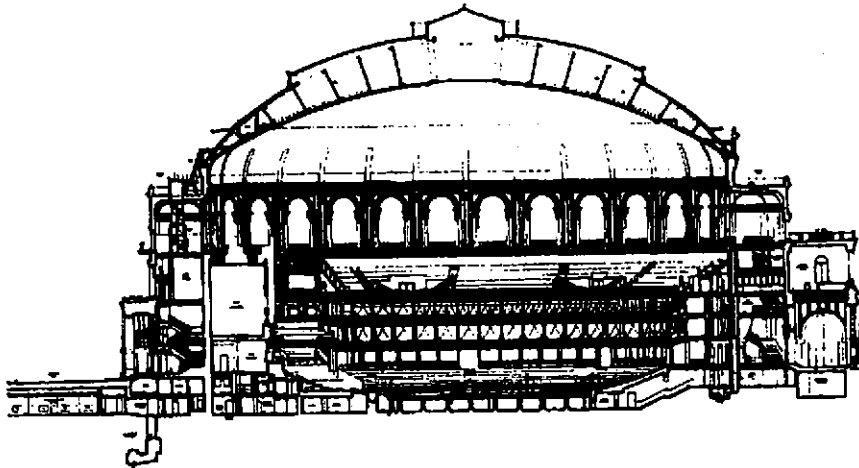
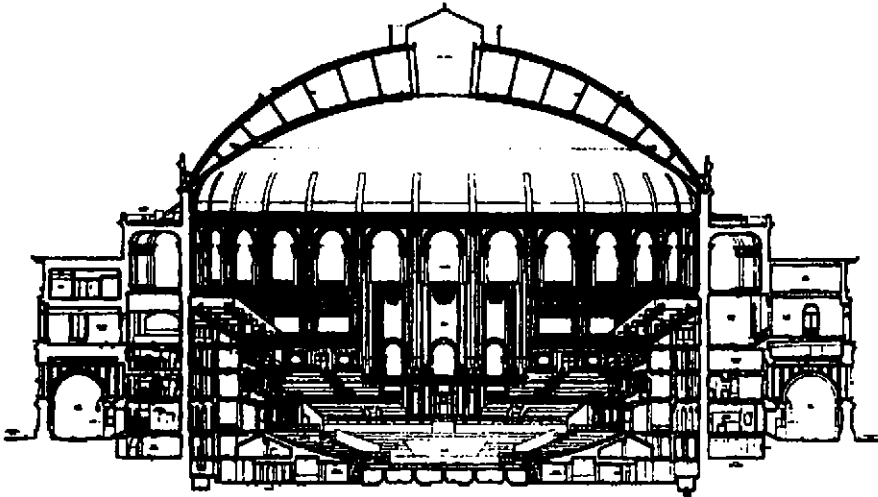
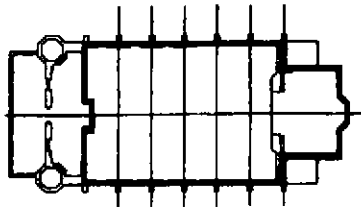
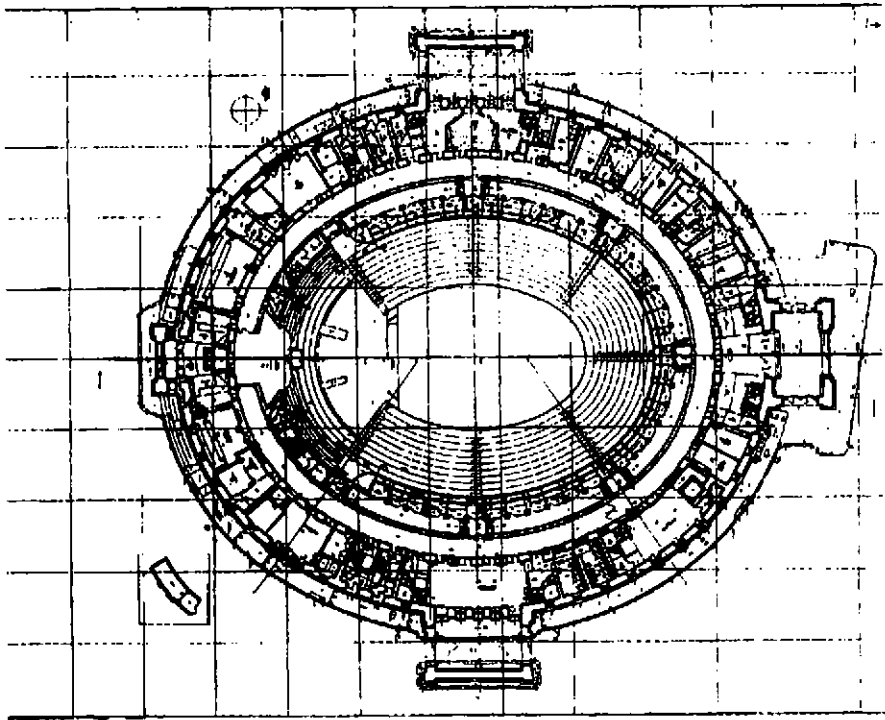
	Hall	Date Built	Occupancy	Reverberation Time (Seconds) per QBCF (Hz)							Status
				63	125	250	500	1k	2k	4k	
1	Great Hall, St Mary's Gate, Derby.	1659	-	2.30	2.80	3.08	3.40	3.26	2.72	1.89	Empty, no seats.
2	The Great Hall, St Georges Hall, Liverpool.	1854	1800	-	6.30	7.10	8.00	7.30	5.30	3.10	Empty, no seats.
3	Victoria Hall, Leeds, Town Hall.	1858	1600	-	3.10	3.50	3.50	3.50	3.50	3.50	Empty, seats in gallery only.
				-	3.00	3.40	3.10	3.00	3.00	2.23	Unoccupied, with seats.
4	Royal Albert Hall, London.	1971	5500	-	2.82	2.86	2.84	2.81	2.58	2.20	Source on stage, unoccupied.
				-	3.12	2.89	2.86	2.78	2.62	2.29	Source in centre of arena, unoccupied.
5	Prichard-Jones Hall, Bangor.	1906	660	3.40	3.30	4.00	4.20	4.00	3.50	2.60	Unoccupied, with seats.
6	Shirley Hall, Kings School, Canterbury.	1956	800	3.01	2.99	2.70	2.77	2.88	2.68	1.87	Unoccupied, with seats.

## MEASURED CHARACTERISTICS OF SIX HALLS FROM 9050 m<sup>3</sup> TO 86,650 m<sup>3</sup>

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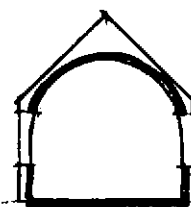
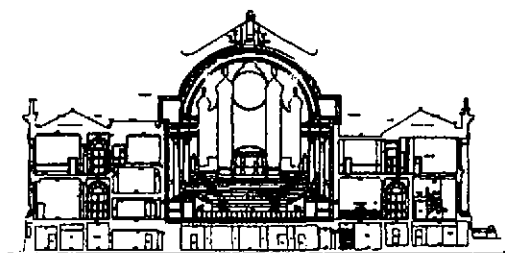
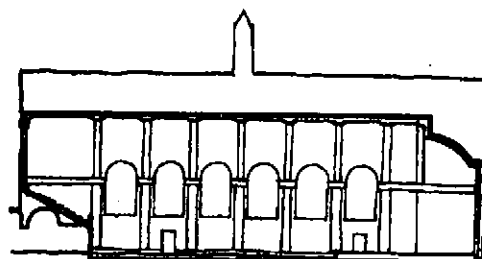
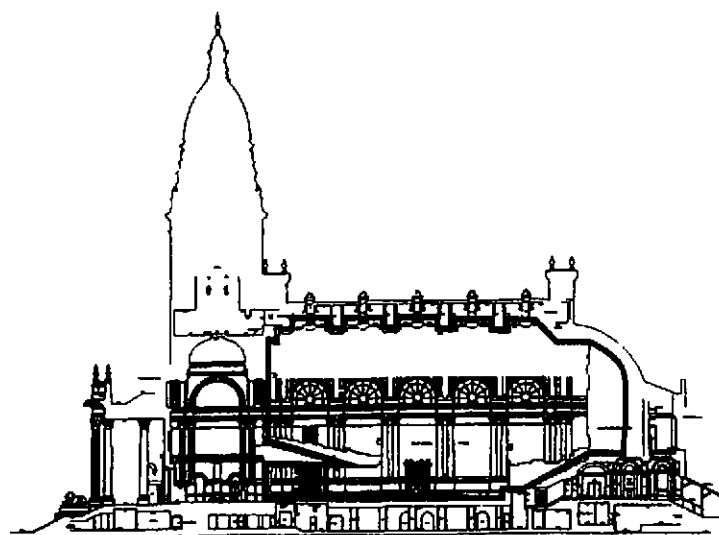
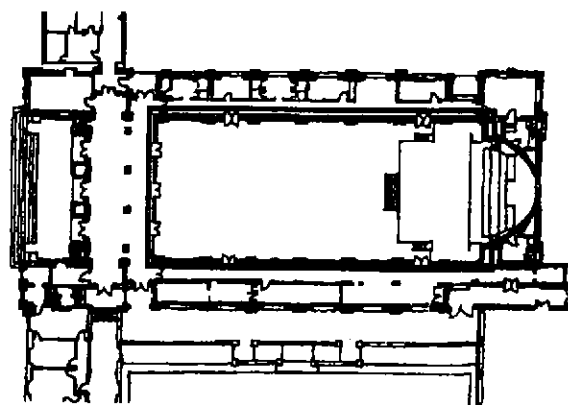
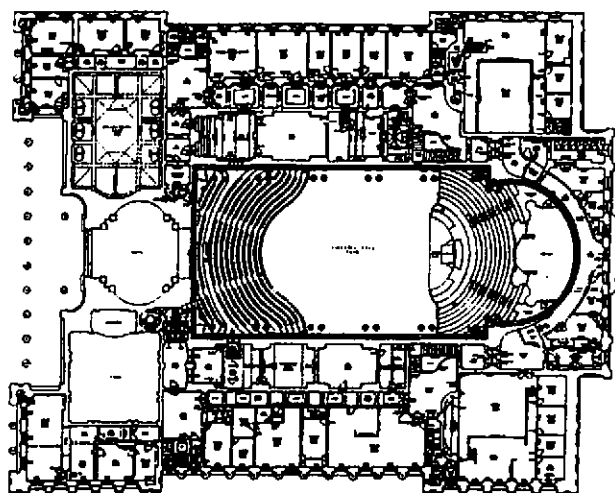


### REVERBERATION TIMES IN UNOCCUPIED HALLS



Royal Albert Hall

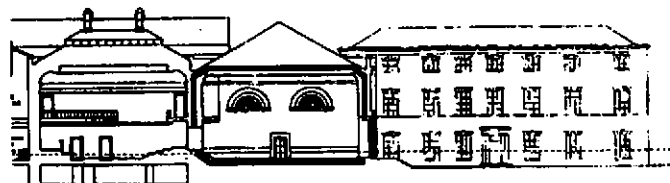
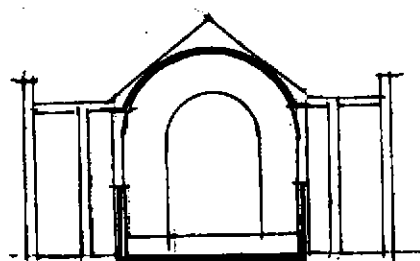
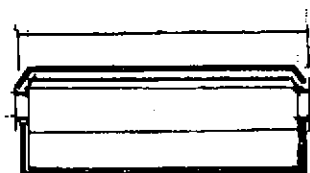
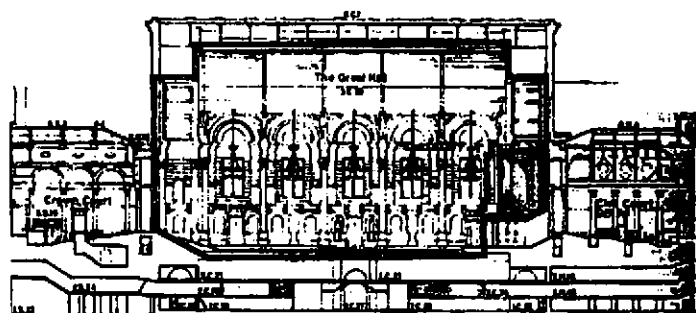
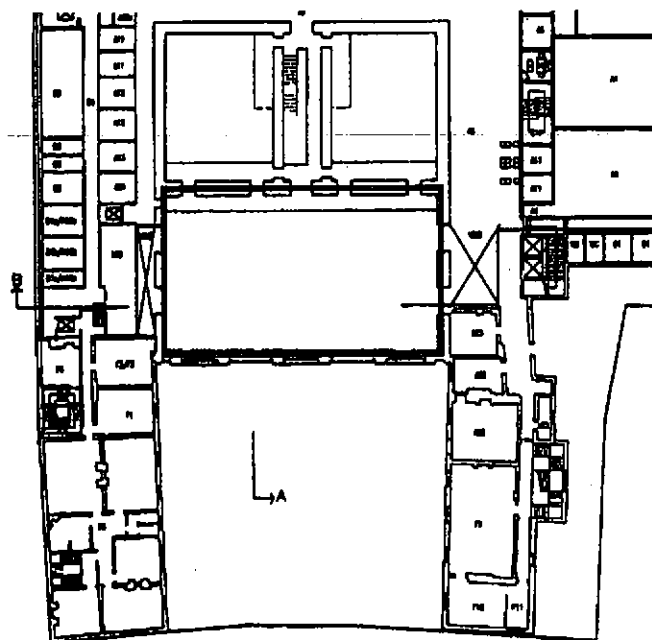
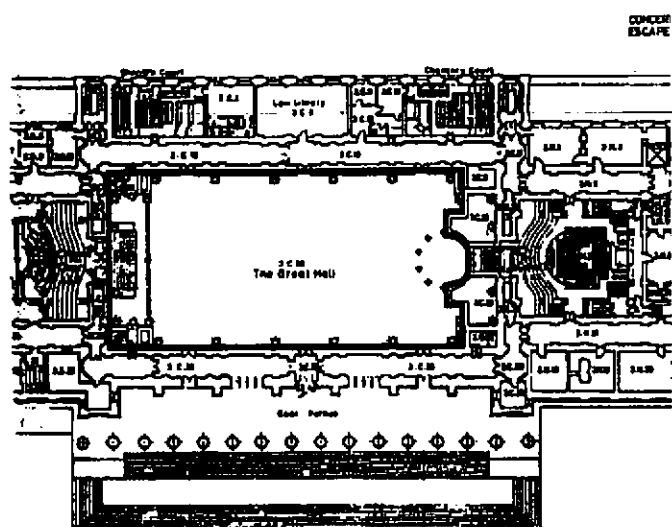
Shirley Hall



Victoria Hall

Pritchard-Jones Hall

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St Georges Hall

Derby Courts