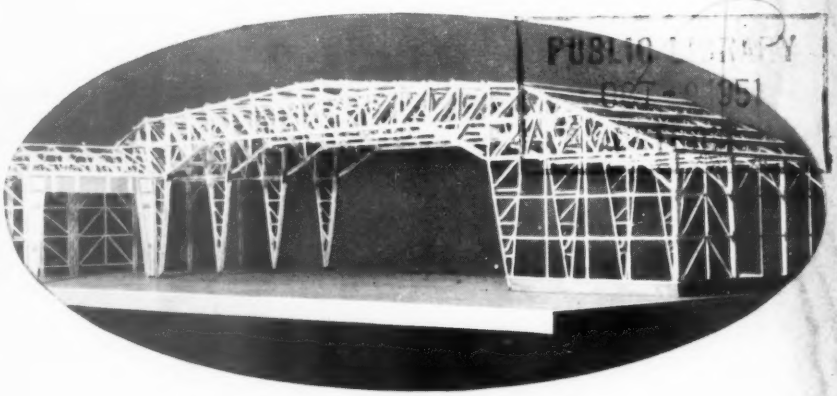
No. 2952 Vol. 114 The Architects' Journal for September 27, 1951. Registered as a Newspaper

THE ARCHITECTS' JOURNAL

BUILDING RESEARCH CONGRESS NUMBER

ONE SHILLING



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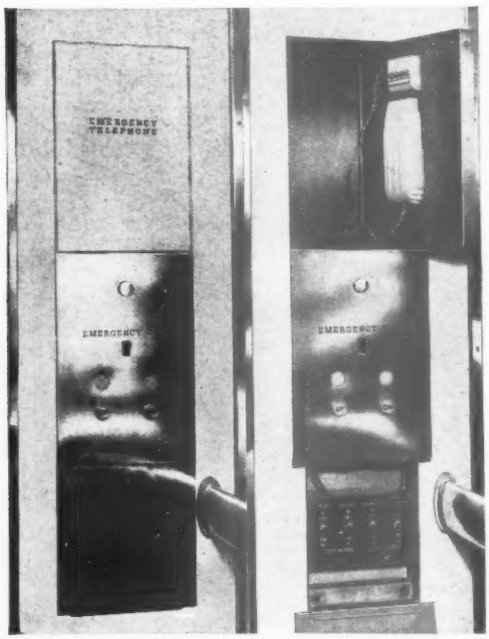

Closed Open

The Car Control Panel

H&C LIFTS gearless lift

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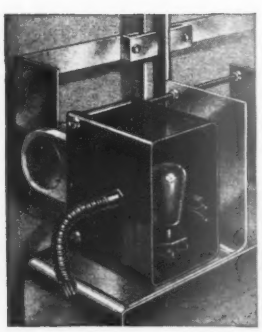
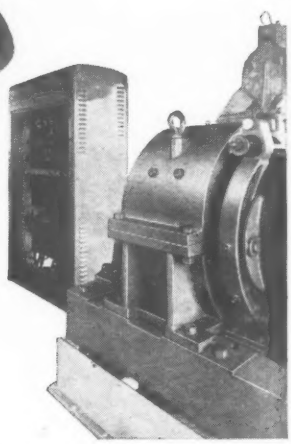
South Bank Exhibition

Hammond & Champness Ltd. have had the honour to be invited to exhibit one of their most up-to-date gearless lifts as an example of the latest and best in British lift design and construction. The complete lift is of standard design, modified only in minor detail for exhibition requirements.



The whole of this lift equipment is of British manufacture and conforms with the code of practice issued by the Building Industries National Council.



The detector unit used for accurate levelling. The control circuit responds to impulses derived from this electronic valve and relay circuit.

Hammond & Champness Ltd.

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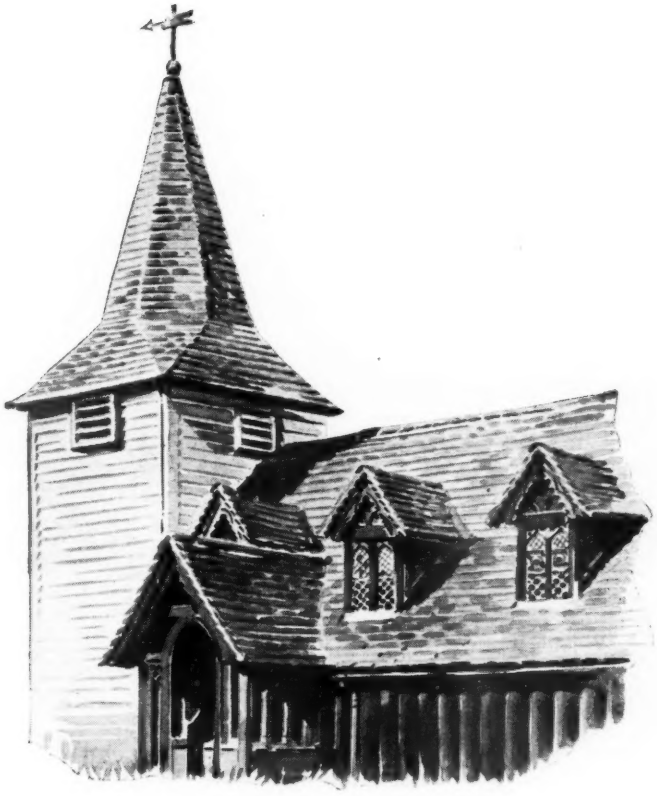
During the day the lift is clearly visible as it travels within the transparent tower. By night, but more particularly from within the grounds, the car resembles an illuminated glass bubble, passing up and down.



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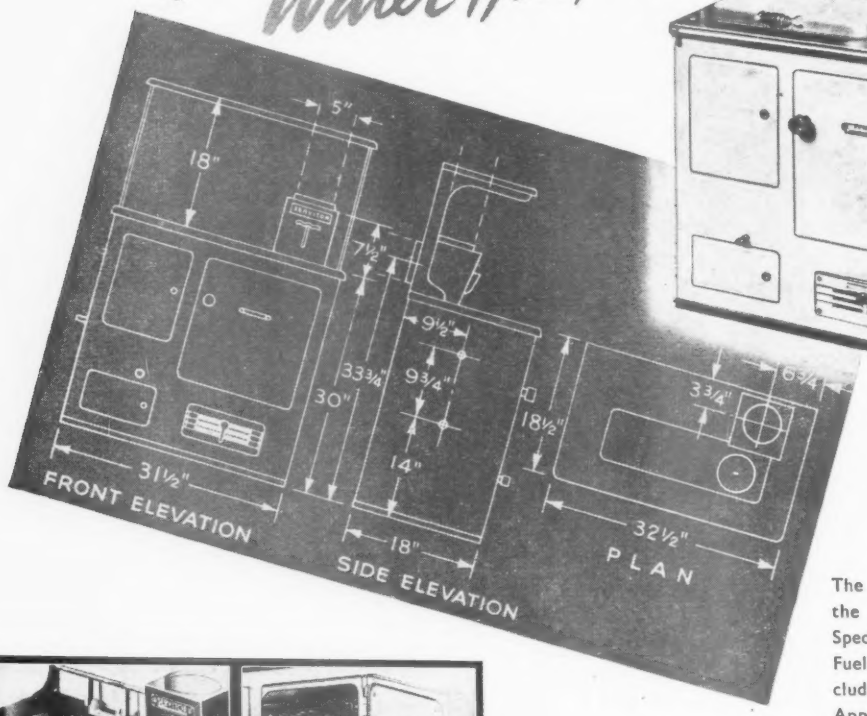
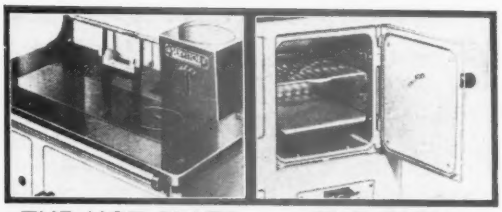
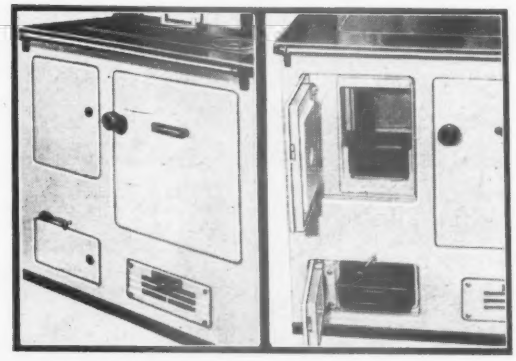


The "Servitor" fulfils the British Standard Specifications for Solid Fuel Cookers and is included in the List of Approved Appliances recommended to Local Authorities.



THE HOT PLATE THE OVEN



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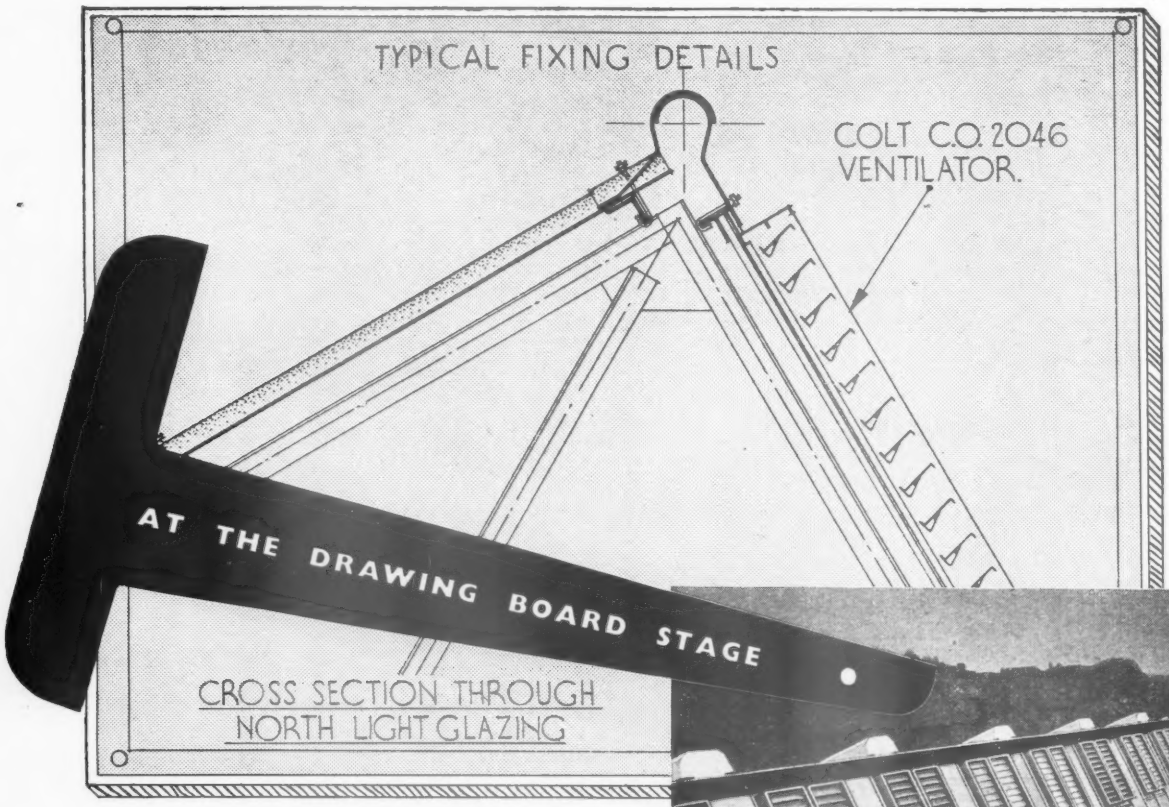

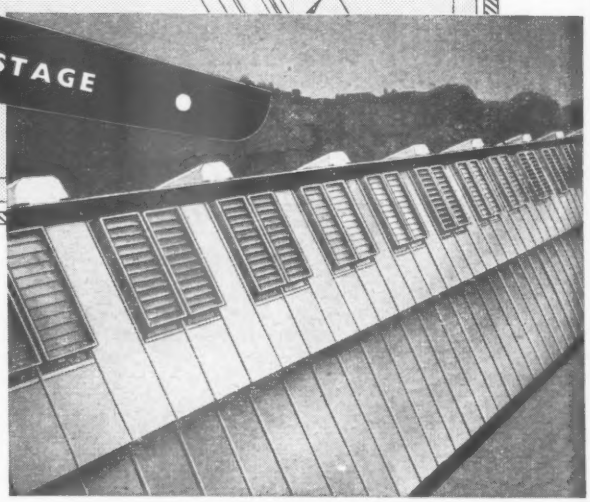

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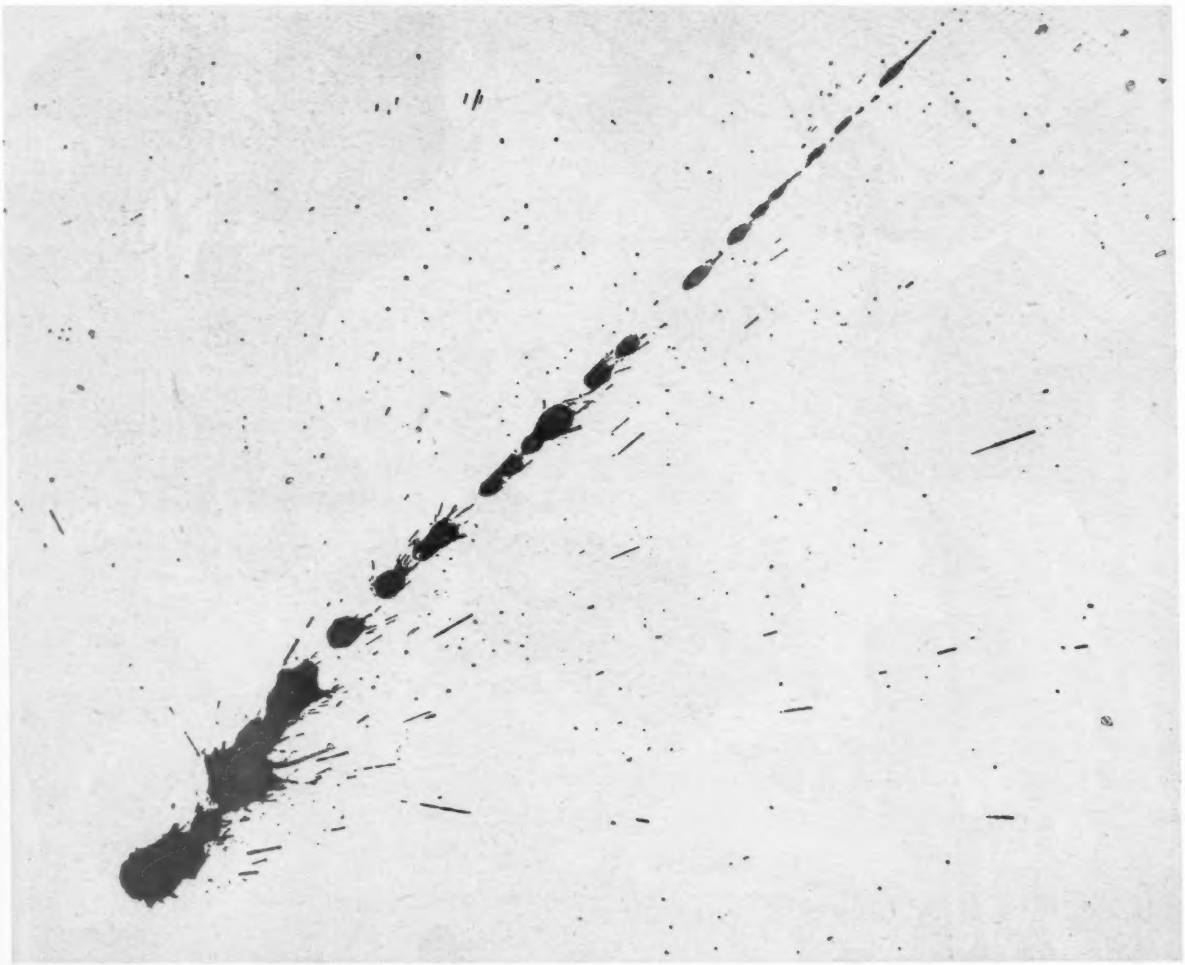

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"The colossal group of an Amazon attacked by a tigress is one of the marvels of the Exhibition . . . though at the same time, it is not entitled to rank with works in the highest class of sculpture" *('Contents of the Crystal Palace', London 1852)*. The operative word, then, must have been 'colossal' for the Victorians liked solidity and bulk. One wonders what they would have made of our modern preference for lightweight materials. Would the architect of 1851 have recognised in Celotex those qualities which have made it so important a factor in modern building construction? Probably not. Yet these same qualities, of lightness, strength and thermal insulation, are today being used to good purpose in buildings of every kind.

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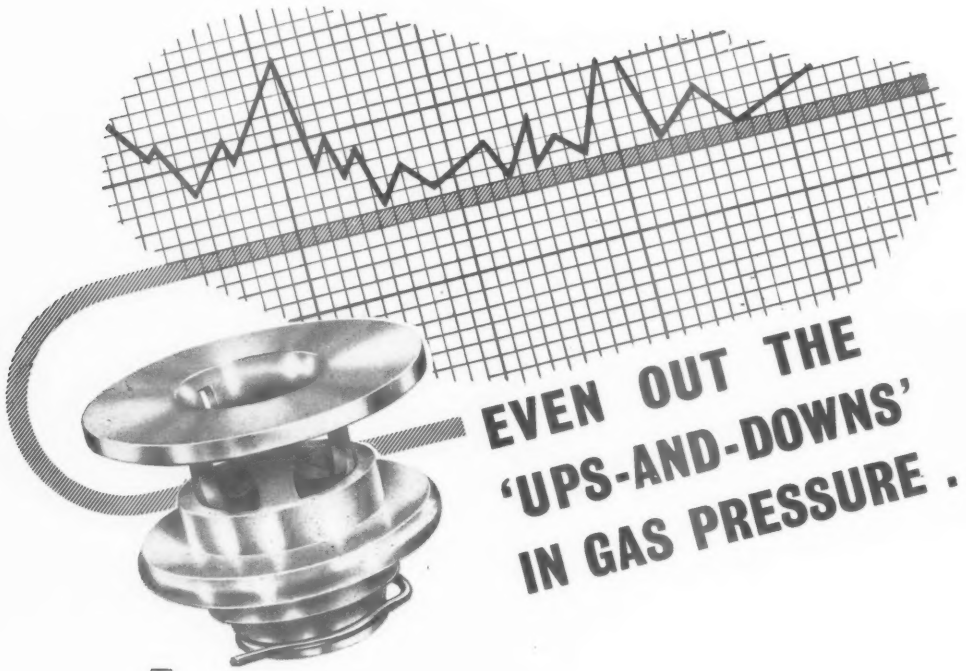

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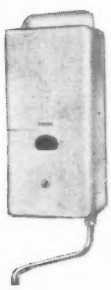

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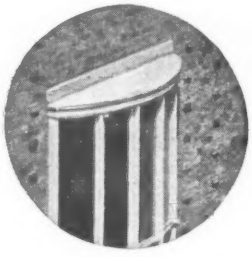
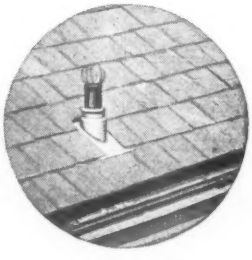
Lansbury Shopping Centre and Market Place, forming part of The Festival of Britain Live Architecture Exhibition.

Architect: Frederick Gibberd, F.R.I.B.A.

LEAD IN LIVE ARCHITECTURE



Lead weathering to bay window



Lead flashing to soil pipe

Examples of the accepted good practice of using lead for flashings and weatherings are to be seen throughout Lansbury Neighbourhood, Poplar. Not so obvious to the eye, but equally valuable from the point of view of economy in fixing and reliability in use, is the lead used for soil and waste pipe connections. And because it can be relied upon to give long service unseen, lead is used also for the water service pipe below ground.

The Technical Information Bureau of the Lead Industries Development Council exists to give assistance on problems relating to the use of lead sheet and pipe in building work. Details of its application are given in a series of information sheets. These sheets are available to architects, surveyors, builders, plumbers and other technicians interested upon application to the Council. "Students" applications should be endorsed by an instructor or master of a technical school.

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B97/6/51

Photograph shows work in progress on the Superstructure to the Uskmouth Generating Station near Newport, Mon., for the British Electricity Authority (South Wales Division)

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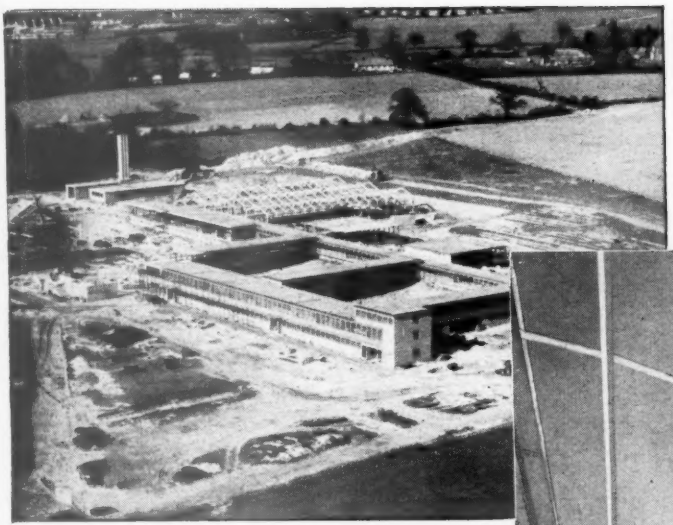
Progress Report...



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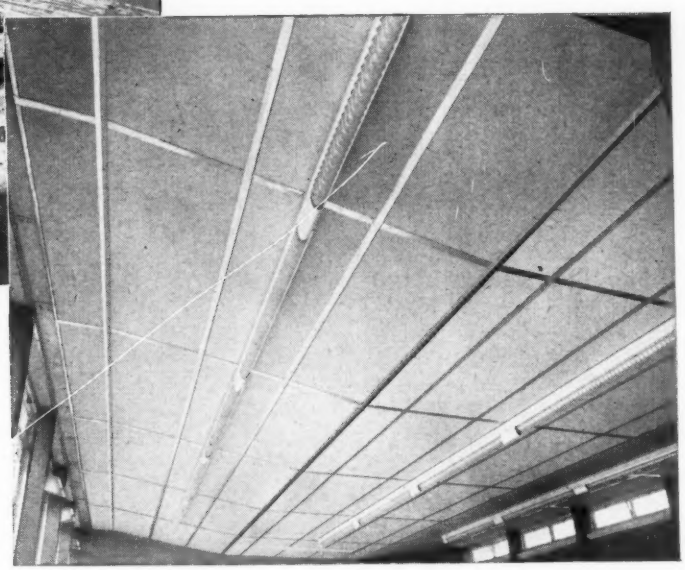

Above: General view of site.

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Photograph by courtesy of British Railways

Terrazzo Tile Flooring in the new Booking Hall at Victoria Station. The colour scheme is cream, with black joints, gold edging and cream in-situ borders. The modern time-table stand in the centre of the hall has a terrazzo-faced concrete base.

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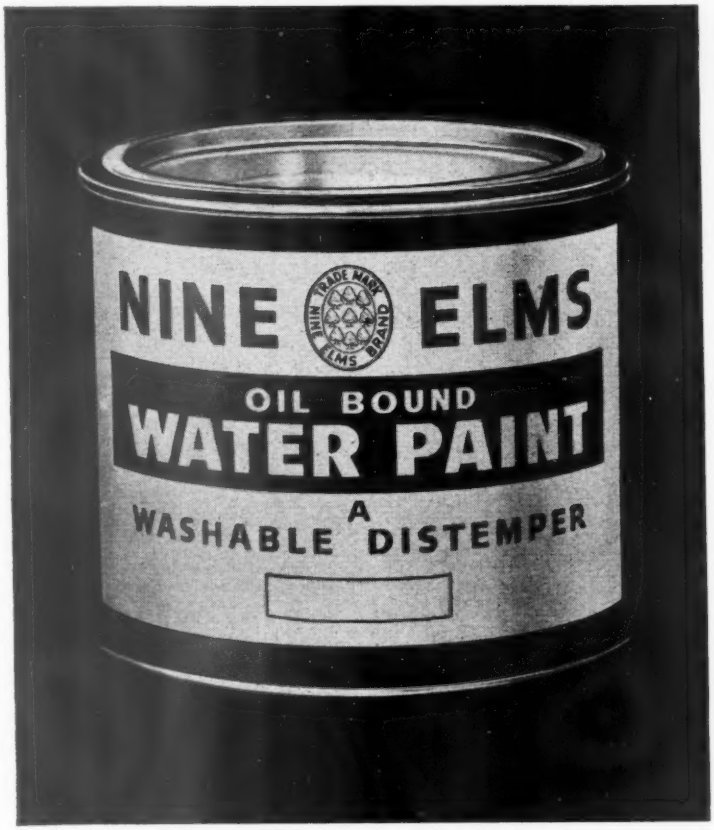

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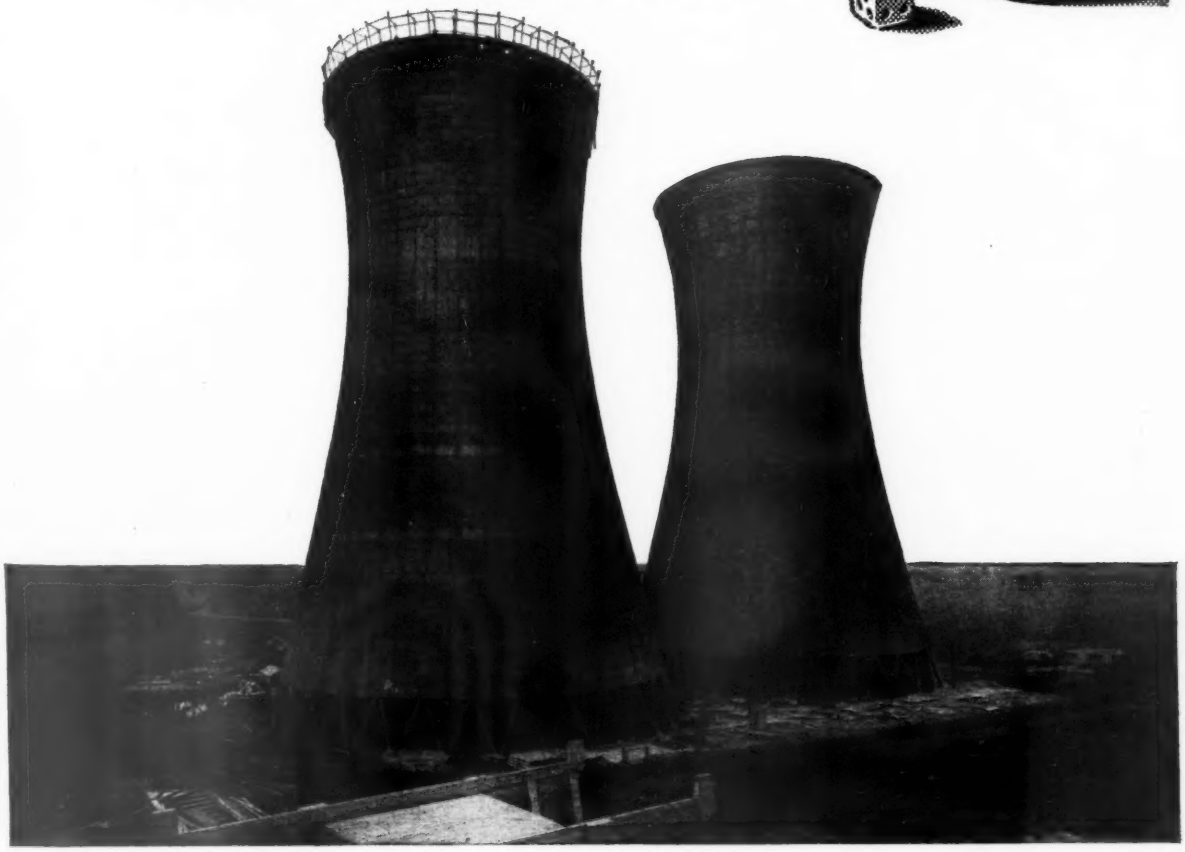

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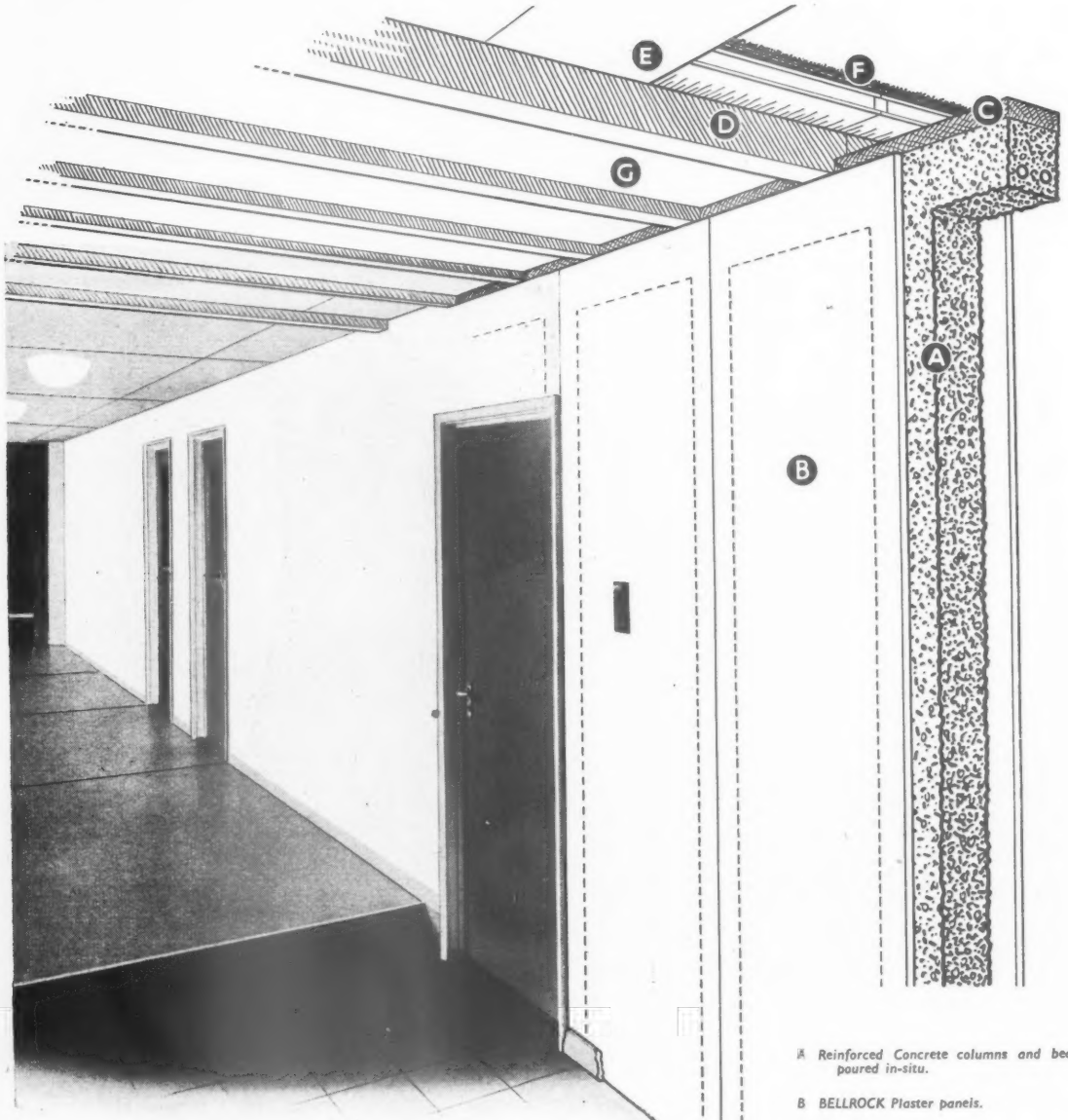

A *Reinforced Concrete columns and beams poured in-situ.*

B *BELLROCK Plaster panels.*

C *Timber Top plate.*

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E *Bellrock Plaster Roof Panels.*

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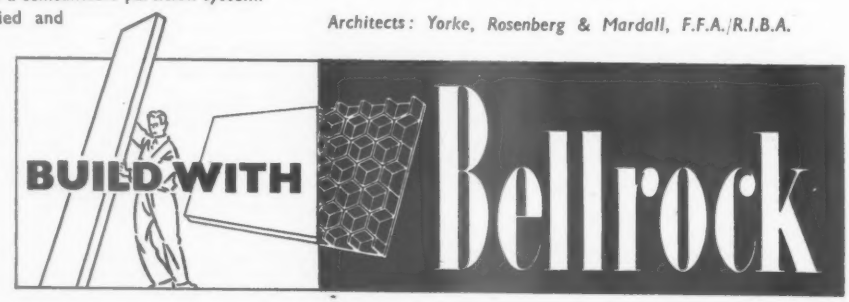

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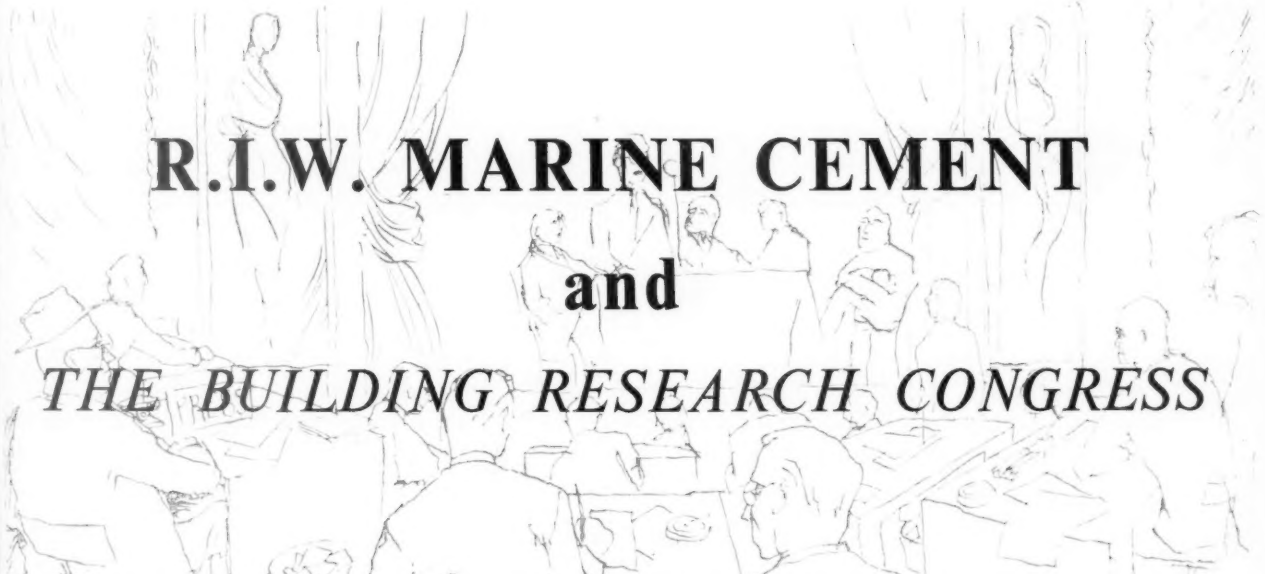

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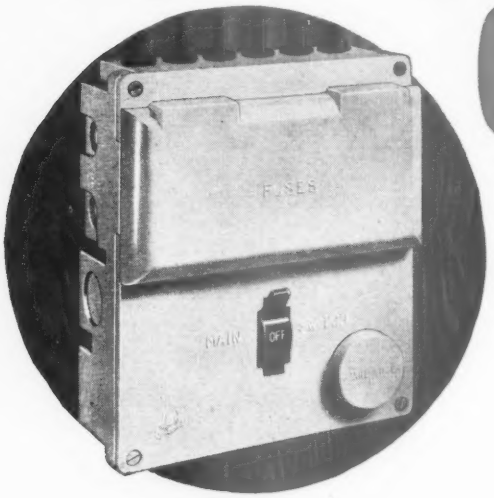

1 Snap-action fuse cover hinged at top.

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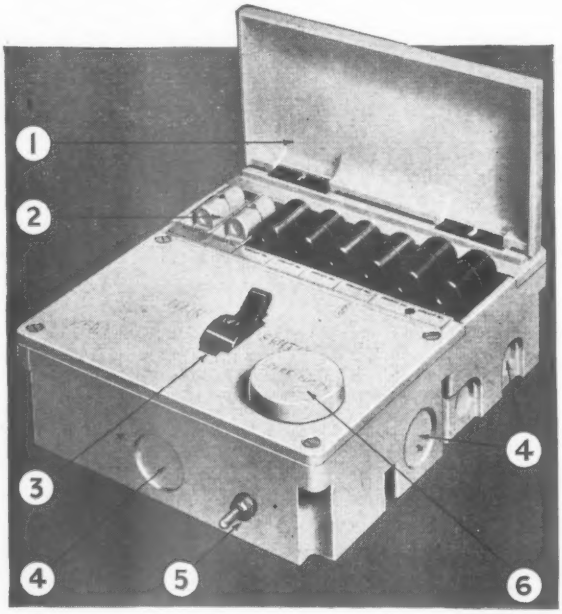

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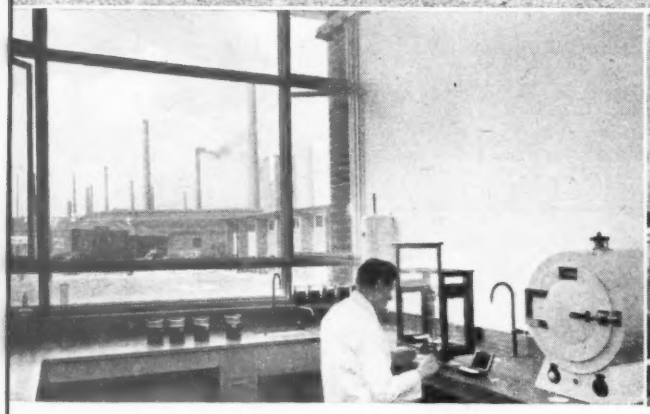

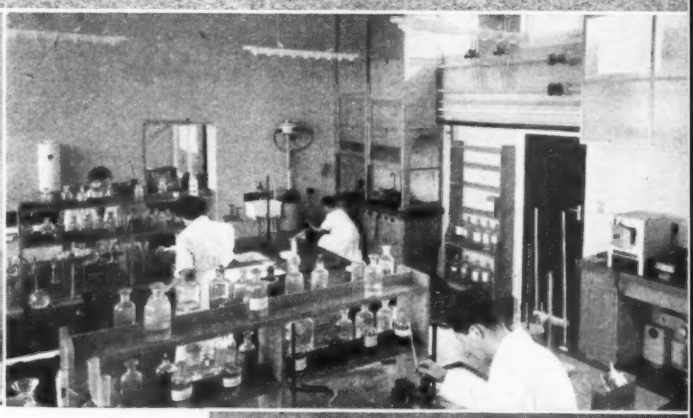

Architect: Cecil C. Handisyde, A.R.I.B.A. *Consulting Engineer: S. M. Cleator.*
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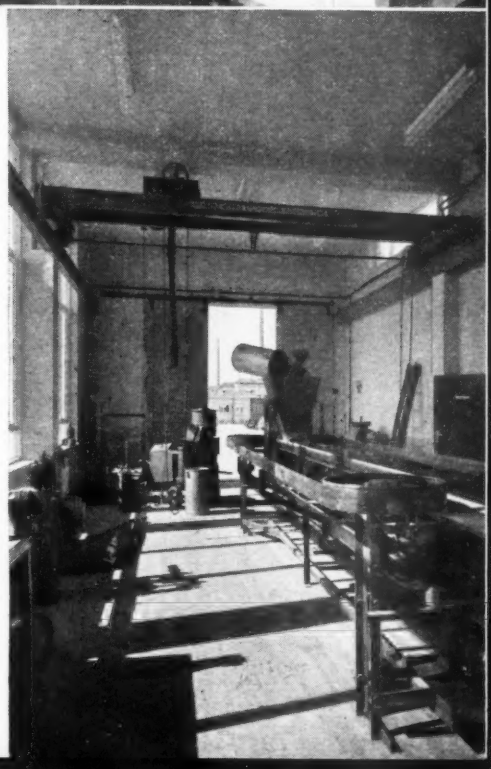

LONDON BRICK COMPANY LIMITED. *Head Office:* AFRICA HOUSE, KINGSWAY, LONDON, W.C.2. Telephone: Holborn 8282. *Midland District Office:* Prudential Buildings, St. Philip's Place, Birmingham, 3 Telephone: Colmore 4141. *South Western District Office:* 11 Orchard Street, Bristol, 1 Telephone: Bristol 23004/5. *Northern District Office:* Gascoigne Street, Boar Lane, Leeds 1 Telephone: Leeds 20771.

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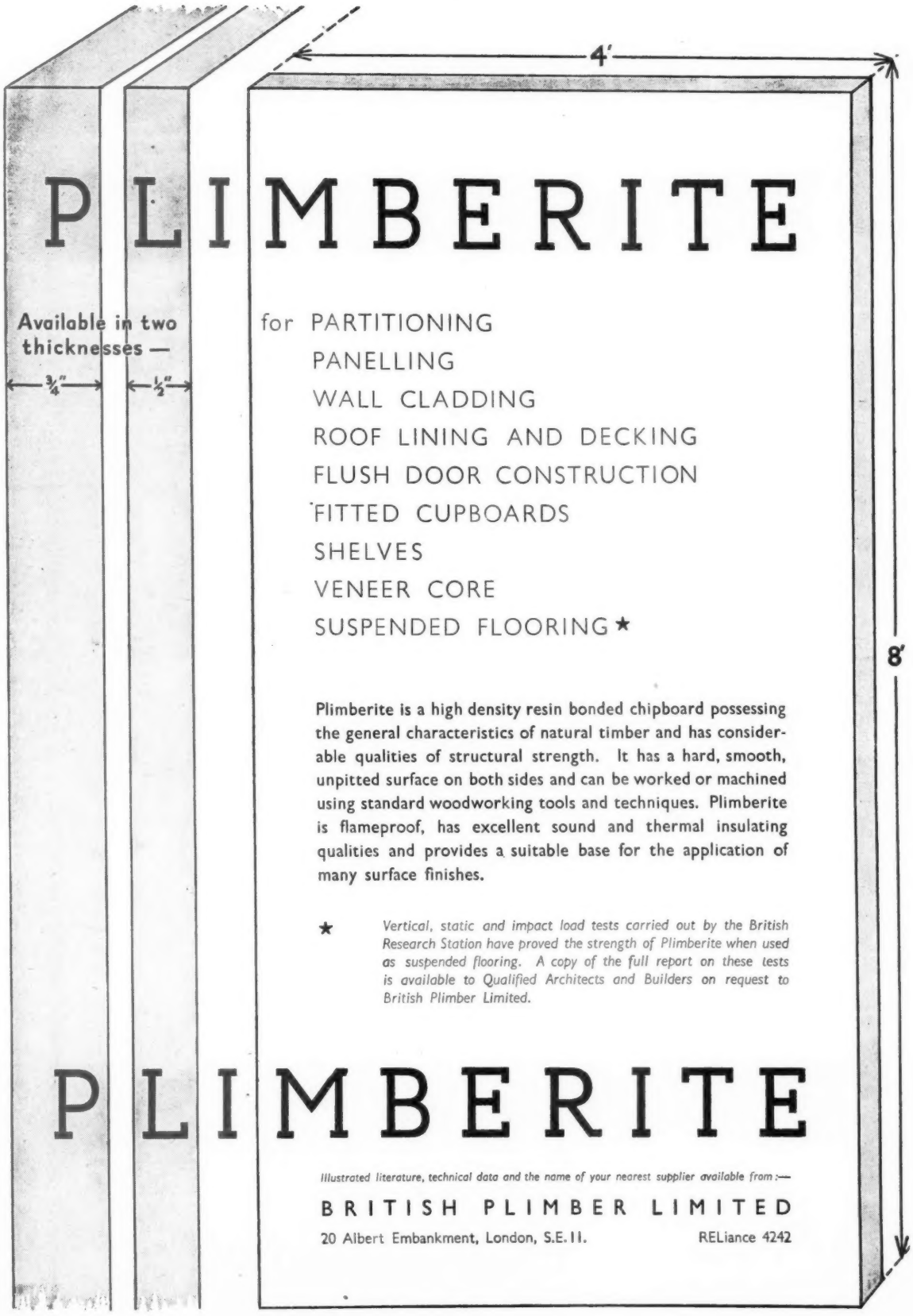

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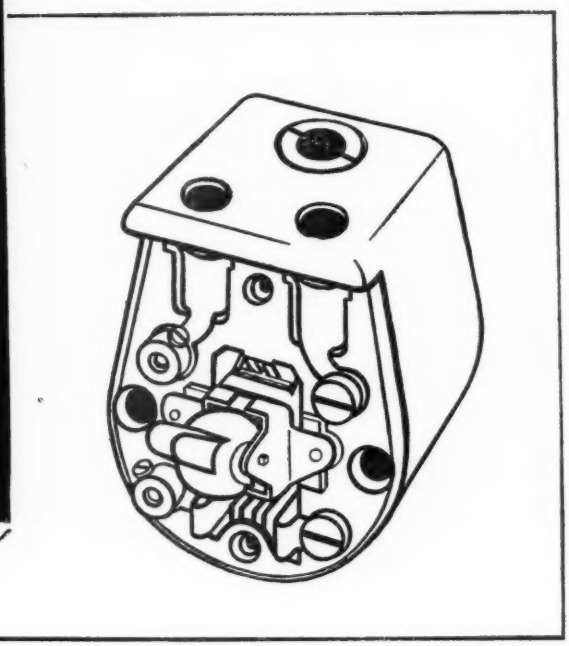

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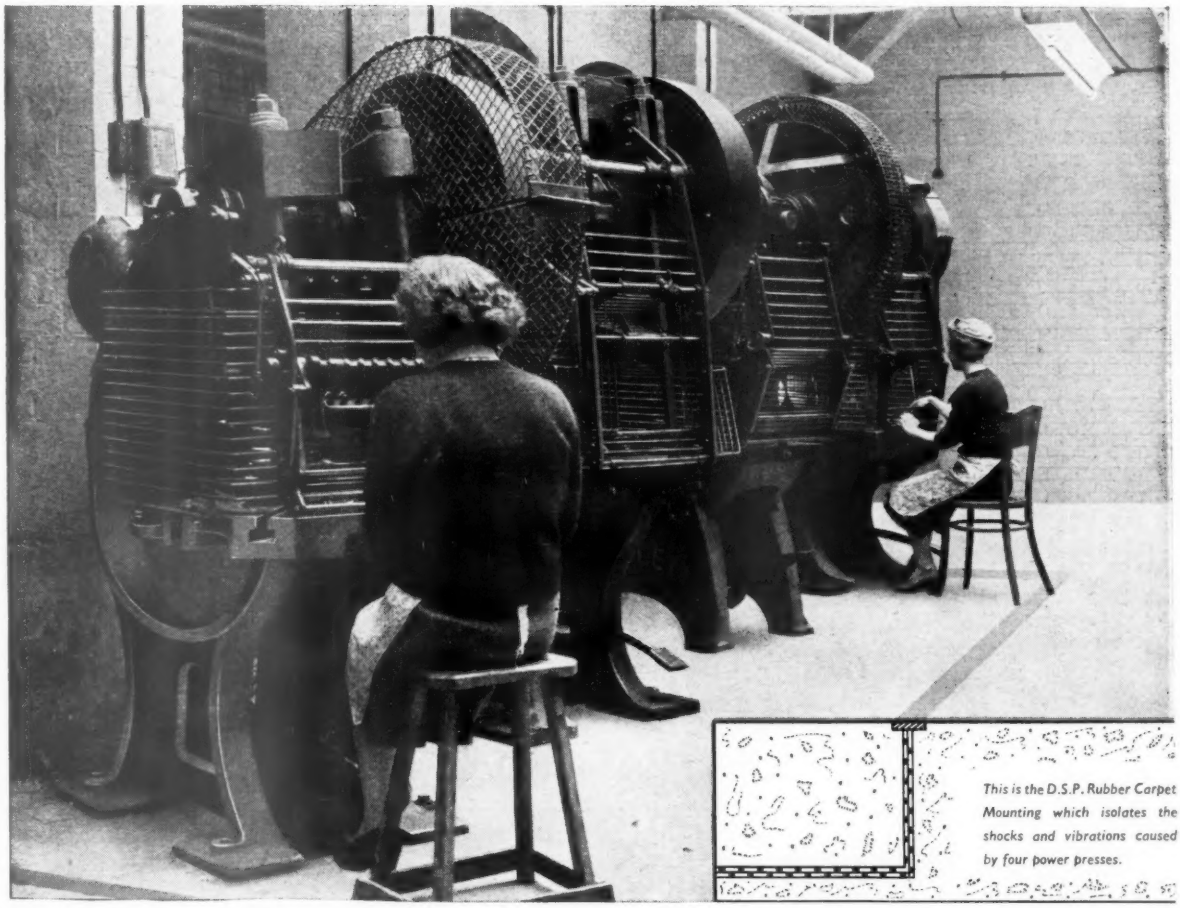

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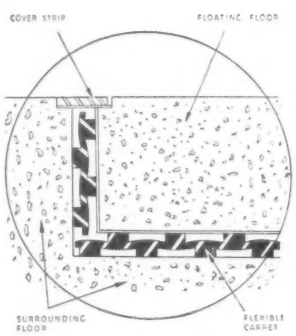

TYPE OF INSTALLATION	AREA OF CONCRETE FLOOR OR FOUNDATION	LOAD CARRIED BY RUBBER CARPET	DEGREE OF ISOLATION OBTAINED
Four Power Presses on a common foundation block	126 sq. ft.	20 tons	96%
Small Power Hammer	17 sq. ft.	5·6 tons	90%
Masticating Mills in a Rubber Factory	410 sq. ft.	121 tons	Maximum movement of surrounding floor ·0001"
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HOUSE OF COMMONS REBUILDING

for the Ministry of Works

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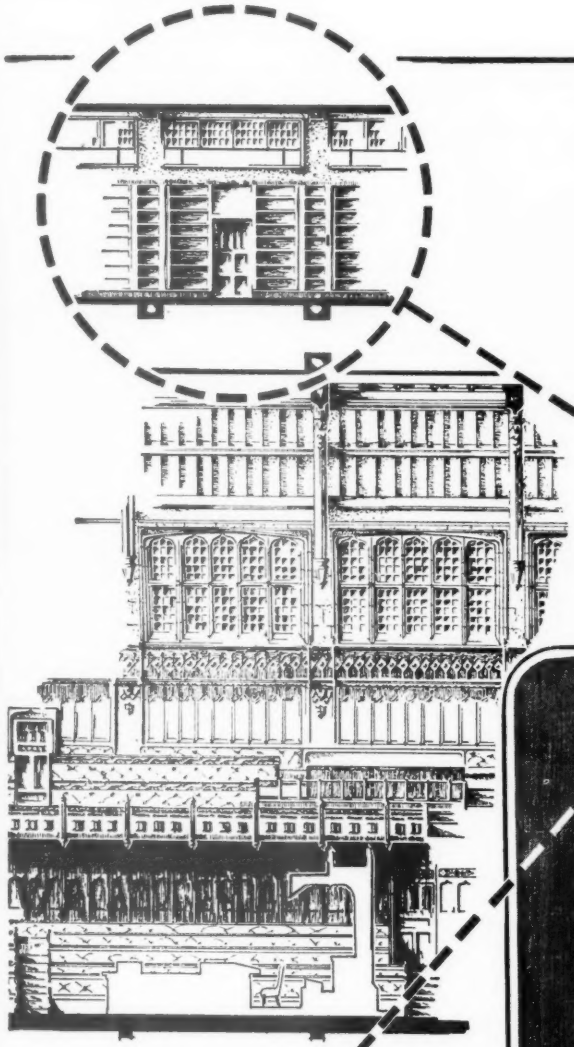
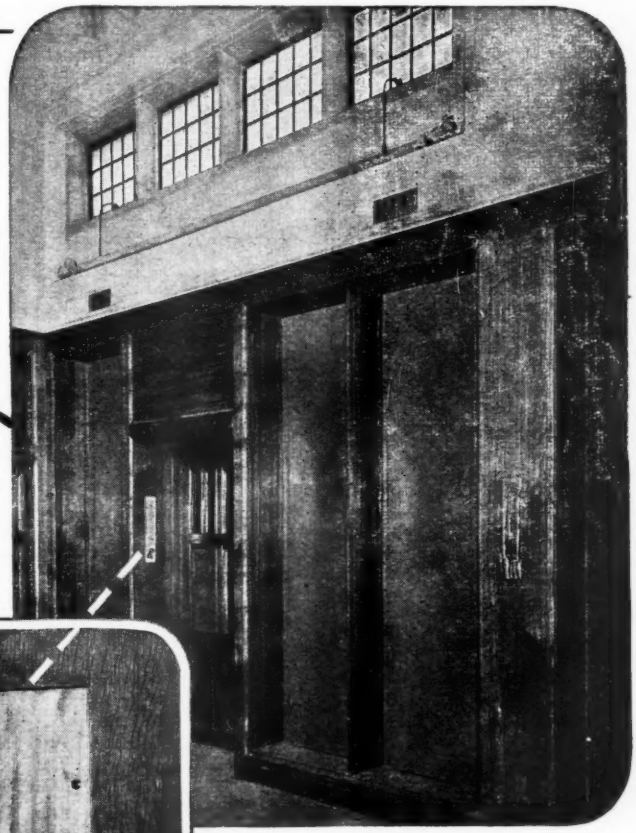
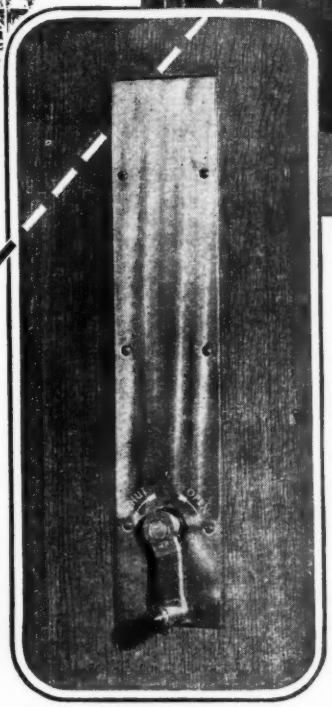
CONTRACTORS: *John Mowlem & Sons Ltd.*

CONSULTING ENGINEER: *Oscar Faber, O.B.E., M.Inst.C.E.*







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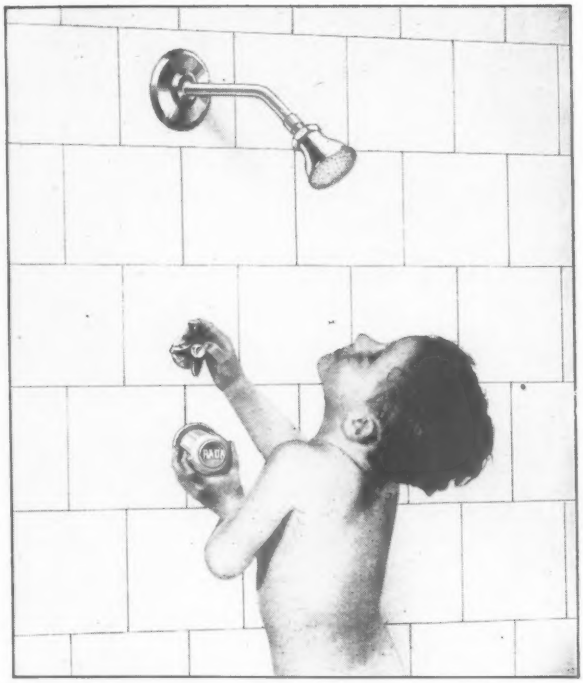

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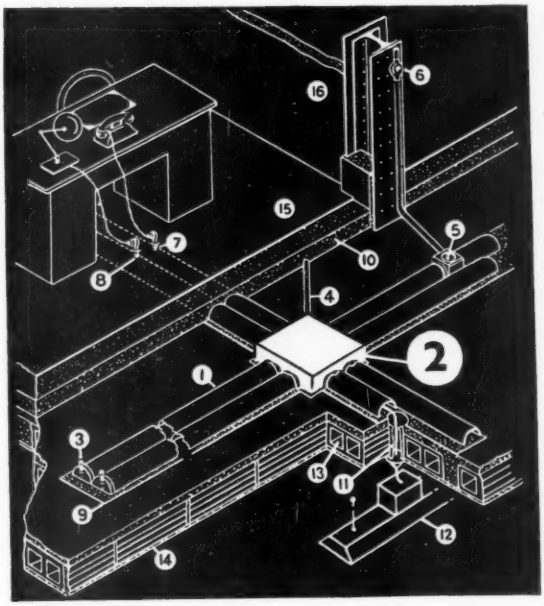

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Many famous buildings throughout the country are equipped with KEY fibre conduits and bear witness to the many advantages offered by this modern system. Lists of important installations can be supplied on request.

Fittings and points no longer present a problem and ducts for lighting or telephone wiring are always there and readily tapped wherever required.

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INSTALLATION OF TWIN CONDUIT SYSTEM (Above)

1. *KEY Fibre Ducts of suitable size for depth of floor.*
2. *Details of access at duct junctions have been omitted in this illustration but are fully described for a double compartment junction in the illustrations below.*
3. *Duct terminal pieces with floor marker.*
4. *Conduit connection from junction box.*
5. *Connector box allows upward and downward connection to ducts on floors above and below.*
6. *Conduit box for switch position.*
7. *Telephone outlet and pedestal* } *Can be installed anywhere on any*
8. *Desk light outlet and pedestal* } *duct.*
9. *Asbestos sheet to which ducts are compound sealed.*
10. *Concrete, pumice, cinder and other floor fill.*
11. *Downward outlet from duct system to ceiling of floor below.*
12. *Pendant lighting point connected to downward outlet.*
13. *Hollow tile or other type of floor structure.*
14. *Ceiling plaster.*
15. *Linoleum or other floor covering.*
16. *Office partition, independent of electrical services and movable.*

KEY
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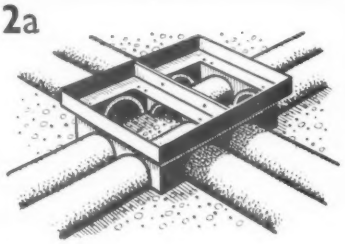
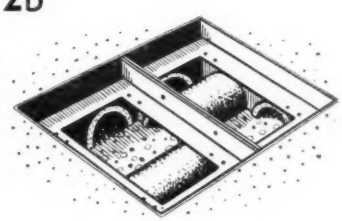
FIBRE UNDER FLOOR DUCTS

2a



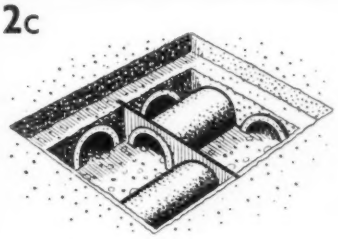
This illustration shows a double compartment former in position before screeding takes place. The twin fibre conduits are clearly shown.

2b



Screeding has now been effected and the metal former is ready for removal by extraction screws in the holes provided.

2c



The double compartment junction after removal of former and before the cast iron fixing plate for the cover is positioned. The cover itself is not illustrated.

Manufactured by THE KEY ENGINEERING CO. LTD.
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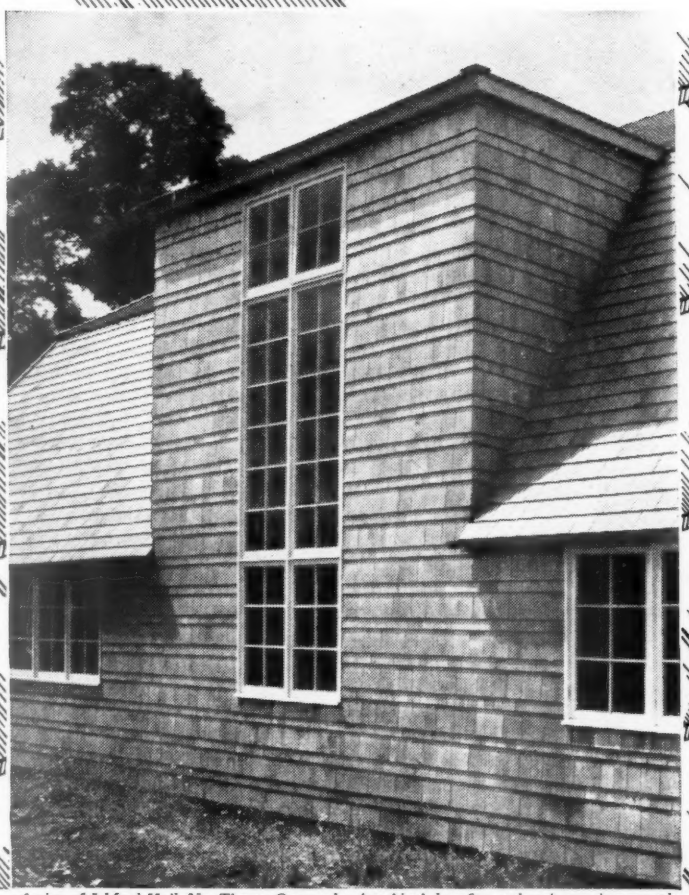
COLT *Canadian Cedar Wood* SHINGLES



A view of Ickford Hall, Nr. Thame, Oxon., showing shingled roofing and an interesting example of vertical shingling to walls. *Architect: Lawrence Dale, F.R.I.B.A.*

FREED FROM LICENCE AND AVAILABLE FROM STOCK

COLT Canadian Cedarwood Shingles are now freed from Timber Control licence and can be delivered immediately from stock ● Expert fixers are available to undertake contracts throughout the country.

The lightness in weight of a Shingle Roof allows 40% reduction in roof sub-structure. ● Neither close-boarding nor sarking felt are required as Shingles form a perfect seal.

COLT Cedarwood Shingles have a long life. ● Their insulation value is 7½ times greater than clay tiles, and they are 21 times more waterproof.

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Standard Thicknesses :
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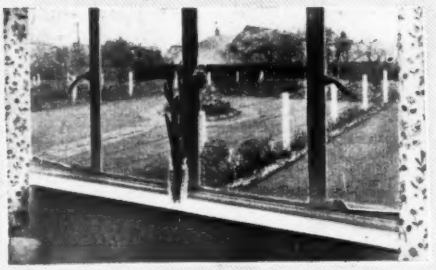
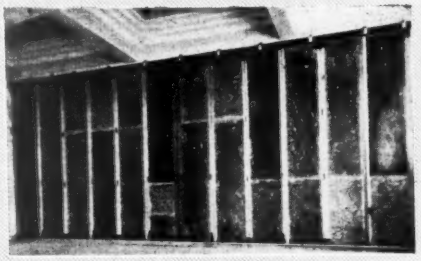


1. A window sill made from a strip of 'Pluto' Board.

2. 'Pluto' Board used for circular shutters, oiled and ready for erection.



3. Fire-proof sliding doors at the Hendon Hall Hotel, awaiting decoration.

4. Corrosion-proof walls of Electro-Plating Works lined from floor to ceiling with 1/8" 'Pluto' Board.

5. 1/4" 'Pluto' Board Balcony Panels screwed to mild steel frame.

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THE ARCHITECTS' JOURNAL

No. 2952 27 SEPTEMBER 1951 VOL 114

9, 11 & 13 Queen Anne's Gate, Westminster, London, S.W.1 Whitehall 0611

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MORE NEWS OF THE SOUTH BANK

Speculation as to the future of the South Bank buildings and the immediate use to be made of the exhibition site continues to pile up. The Government "working party" I wrote of a couple of weeks ago has been busy sifting the ideas that have been put forward, and is expected to make some sort of announcement at the end of this week. A few days after these words appear, therefore, the position should have been somewhat clarified.

*

Meanwhile my own estimate of the probabilities is as follows. First the upstream section, all of which has been leased to MOW for Government offices except for a strip along the river front, which the LCC is to lay out as gardens. MOW say the offices haven't been designed yet and that they don't know when building is likely to start. But they are said to be contemplating taking over the site at once in order to start excavating for various subterranean installations. This would, of course, involve the immediate demolition of the principal upstream exhibition buildings (including the Dome of Discovery) and would confront us for some years to come with a large hole in the ground surrounded by a fence.

That would indeed be a sad ending to the good architectural efforts of the Festival. It is greatly to be hoped that MOW can be dissuaded from this project and will wait to dig their hole till they are ready to go ahead with the whole of the office buildings. On the LCC's garden strip, the only buildings are the '51 Bar (which might well be left permanently, in order to give vitality to what might otherwise become a dull promenade), the Sea and Ships building (which is hardly adaptable to other uses and will presumably be pulled down forthwith) and the Regatta.

*

I know the preservation of the Regatta (as a restaurant) has been discussed, but I am afraid it's not likely to happen. There are the financial risks, and the LCC's unwillingness to set up a rival to the Royal Festival Hall restaurant—and other arguments. But I wish our local authorities were more inclined to *take* risks occasionally. I suppose their answer would be that the country's economic position doesn't allow this.

*

In the downstream section I believe it is likely that the shot-tower will remain, at least till the National Theatre building can start; also that the Rodney pier will remain permanently (the Nelson, upstream, pier will definitely go). There is a better chance of the Thames-Side restaurant being kept on, if a private caterer can be found to run it and if it doesn't prove too difficult to instal the heating which will be necessary if it is to be open in winter. It has a delightful situation, is not at the moment in the way of anything else, and caters for a "popular public" and so would not compete with the Royal Festival Hall.

*

I think there is a very good chance of the Arts Council being allowed to turn the Lion and Unicorn building, at least temporarily, into an art gallery. There are technical difficulties (such as, once again, heating) but it is a first rate idea and is getting a lot of support. It also seems almost certain that Edward Mills's administration building will be kept as offices—perhaps occupied by the COID.

*

Finally there is the most interesting idea that BEA might take over the Homes and Gardens building, moving their passenger departure and arrival stations there from Kensington High Street. This is now being discussed by the corporation. The site has obvious advantages for this purpose, and at least, with the round-the-clock coming and going that air travel involves, there would be less danger of the whole exhibition site relapsing into desuetude.

*

There is one more point that needs stressing, especially in view of the varied uses being considered for the exhibition buildings: the *unity* of the whole area must somehow be preserved. This could be done by preserving as much as possible of the exhibition landscaping and planting, which contributed so much to the rehabilitation

of the South Bank. I hope the LCC Parks Department have this in mind.

HAPPY HOMESTEAD

When my host for the evening told me I was to be involved in a social experiment I wasn't altogether enthusiastic. If all social experiments were like this one, however, you would hear no more from your old friend ASTRAGAL: he would take up the career of professional guinea-pig tomorrow.

*

The laboratory in which this particular experiment is being conducted is Welwyn Garden City, now part of the realm of the Hatfield New Town Development Corporation. As you will know, through Welwyn Garden City there runs a railway; and, as you may deduce from your knowledge of other places that have railways running through them, that railway has a "right" and a "wrong" side. In Welwyn, in fact, east-is-east-and-west-is-west-and-never, etc.

*

Or at any rate east and west *were*, and didn't. Today the Corporation is trying to right the wrong and make east west, so to speak. With that object in view it has opened, in a new block of flats on the "wrong" side of the railway (Louis de Soissons and Partners, architects), a restaurant. And in that restaurant I was given one of the best dinners I have eaten this year—starting, suitably enough, with Purée Soissonaise.*

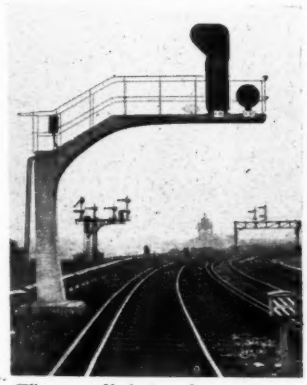
*

At Homestead Court—make a note of the name—the carpets are thick, the decor is discreet, the furniture is such as you go to Heal's for, there is a large bar (not yet licensed), and the prices on the menu are neither higher nor lower than they should be: everything has been done to make the right people forget that they are on the wrong side of the railway. Or very nearly everything. For there is just one rude—or at least rather uncivil—reminder that this is, after all, part of a social experiment: those who want to wash their hands are not Ladies and Gentlemen, but Men and Women.

FOR DISPOSAL

I learn that if the demand is sufficient the FOB are prepared to dispose of some of the fittings and furniture on the South Bank in the form of small lots—possibly at an auction. They have had quite a number of requests already from seekers of mementoes—one of the most frequent being for: "two or three doves from the Lion and Unicorn Pavilion." (Will these be the cherished souvenirs sought by the exhibition designers of 2051 for hanging in a miniature replica of the Dome?) Some of the murals and statues are for disposal, too, though I believe that the future of most of the latter has been decided. In the case of Barbara Hepworth's *Contrapuntal Forms*, the stone figures which stand beneath the overhang of the Dome, I learn that they are to be placed in the vicinity of Maxwell Fry's flats at Harlow. So, if you hanker after the only straw lion and unicorn in existence, a genuine husky or a set of garden chairs, stake your claim at 99A, Regent Street.

* A soup of mixed vegetables.



These well-designed gantries were the work of the Civil Engineer's Department, British Railways (Southern Region). (Nationalisation being what it is, Astragal has been asked not to reveal the designer's name.) The gantries are situated between Clapham Junction and Victoria (top); between Norwood Junction and Bricklayers Arms Junction (above left); and between Clapham Junction and Wandsworth (above right).

BUILDING RESEARCH AFTERTHOUGHT

Thinking over what was said at the Building Research Congress I begin to wonder whether it did not run a bit too smoothly. There was just that suggestion of mutual congratulation by everyone for everyone for being so enlightened and research conscious that I felt my hand reaching instinctively for a cat to put amongst the downy birds. It was a splendid achievement—there's no denying it—but little emphasis on the fact that the aim of all research is simply more, better and cheaper buildings in less and less time.

The Congressional Spirit

In this issue we are completing our report of the Building Research Congress, 1951. Summaries of papers presented to the Congress and the discussions which followed them will be found on pages 371 to 393. This was the first international congress of its kind and it has shown how valuable a regular programme for co-ordinating world-wide building research could be. Although few startlingly new ideas have come forth, the Congress has provided a valuable opportunity for scientists, architects and engineers from many countries to meet together informally.

One of the informal meetings which took place during the Congress is the subject of our frontispiece. On the left of the photograph, which was taken in our private pub, is P. Arni and his wife. Mr. Arni is a Finnish acoustics consultant, and worked on the Institute of Economics in Helsinki, which was described in the JOURNAL for September 13. Sitting in the centre is Ian Langlands, of the Commonwealth Building Research Section, and on the right, with his back towards the camera, is J. Bickerdike, a research worker of the Building Research Station.

Why the hurry? The reason lies not merely in slum-ridden Europe but in the virtually unhoused millions of Africa, India and China: a problem we just haven't begun to tackle.

TARGET OR PROMISE?

The election news makes me wonder what promises the different parties are going to make about housing. Whether it was inspired timing or not, the Liberals published their programme on the morning of the election announcement. They point out that 100,000 extra houses will need about 1,000,000 extra tons of coal to produce the materials and about another 650,000 tons a year for heating them. Their suggestion is that for the next three years 70 per

"200,000.....300,000"

cent. of the houses built should be of 700 square feet, though with rooms to Housing Manual sizes; this on the assumption that 1,000 square feet is far larger than necessary when the average household for the whole country consists of only 3·2 persons. I shall be interested to hear what the other parties say, though I suspect that performance will lag quite a long way behind promises whatever they say. Incidentally, builders have kept very quiet about the Tory 300,000. In fact, as Mr. Gammans pointed out the other day, no association of builders has ever stated how many houses they could build or what the conditions are which the builders would require to enable them to build them. Why not?

ASTRAGAL

The Editors

BUILDING RESEARCH CONGRESS

THIS week we devote the major part of the JOURNAL to publishing, necessarily in brief, the discussions which took place at the Building Research Congress, 1951. We have endeavoured to select for reporting only those subjects most nearly the immediate concern of the architect. Obviously, at such a Congress, little can be said which has not been heard of before. New ideas do not wait for such important occasions before being born. Perhaps, anyway, the most valuable aspect of such a congress lies outside the congress proper altogether, in the opportunity it gives for the informal and free exchange of ideas between men of different nations after the meetings are over.

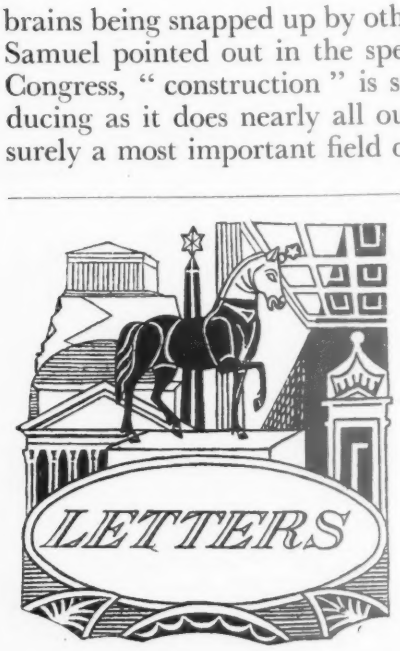
In any attempt to evaluate the results of the Building Research Congress, one point has emerged most clearly :—the need for more research into the fundamental nature of building materials. Speaker after speaker emphasized this need. There comes a point in all research where, in order to go further forward, one must know a great deal about the actual structure of each material and what changes take place inside it under various conditions, in particular those due to loading and those due to weather.

Unfortunately, since the results of what might be called "pure" research are not always obvious, it tends to be neglected and sufficient money is seldom forthcoming for it. It is good to know, therefore, that there are, at least, two teams of scientists in this country working on this fundamental type of research, under extra mural contracts with DSIR and in close collaboration with BRS. One team, under Professor J. D. Bernal at Birkbeck College, is studying cement and concrete ; the other, under Professor J. F. Baker at Cambridge University, is studying steel.

Professor Bernal's team has already worked out the molecular structure of cement and the team's work on set concrete is very advanced. Professor Bernal's theory is that there is nothing unique about portland cement, as such, which makes possible cementitious action, and that, under suitable conditions, there is no reason why it would not be possible to produce stone-like materials from many sedimentary substances, without the use of a medium like portland cement. In fact, we already manufacture one product based on this principle—the sand-lime brick. For this, no cementing agent is used ; the bond between the sand is brought about by the action of high pressure steam on the silica and lime added to the mix. The possibility of producing new materials of this type might bring about far cheaper building and emphasises the importance of the type of work these teams are carrying out.

For more research of this nature, money is not the only prerequisite ; it is also necessary to find men with a sufficiently empirical outlook to tackle such basic issues. But if more attention were paid to this problem and if more finance were available, it might be possible to prevent most of the best

brains being snapped up by other industries. For, as Viscount Samuel pointed out in the speech with which he opened the Congress, " construction " is second only to agriculture, producing as it does nearly all our physical environment, and is surely a most important field of human endeavour.



Frank Shaw
Colin Oates
Planner

Lansbury : The Views of a " Private Individual "

SIR,—The recent complaints of Mr. Sisley and Mr. Hinton about the JOURNAL'S uncritical enthusiasm are made even more pointed by the issue on Lansbury (September 6), which adds insult to injury.

Do the editors honestly believe in the "outstanding architectural quality of the public buildings" or that some of the housing can be excused as "consistently good if not imaginative"? If this is merely professional tact, it seems odd that one editor should fairly speak his mind about the South Bank in the *Review* while being tactful about Lansbury in the JOURNAL.

The editors seem convinced that the fight for modern architecture must be Fabian, but surely it can be more direct than in this Lansbury issue which is so circumspect as to be quite misleading.

Lansbury, as Town Planning, is a subject about which there are various opinions, but the individual buildings, with honourable exceptions, are disappointing, and if the JOURNAL has no courage to say so, private individuals must.

FRANK SHAW.

London

[Having taken the lead in the recent campaign to get architecture more freely criticized, the JOURNAL cannot fairly be accused of lacking the courage to express adverse opinions. Whether the publication of an objective survey of a still unfinished scheme, is the moment also to launch an attack on it is another matter.

The writer of this letter can rest assured that the editors of the JOURNAL will not hesitate to write critically of such elements in the Lansbury scheme as deserve it when the moment seems ripe for doing so.

Meanwhile the two phrases the writer objects to should be re-read in their context and considered in relation to work going up elsewhere. "Consistently good if not imaginative" seems to be quite a fair interim assessment of the standard of Lansbury housing, compared with the general run of municipal housing, and the architectural quality of the public buildings as a whole, whatever their individual shortcomings, *does* stand out when compared with equivalent work elsewhere. Where else in so small an area can two new schools, a new church and a new shopping centre be found equal in standard to the work at Lansbury? In the view of the editors it represents a step forward, and the planning of Lansbury as a whole represents a move in the right direction for which credit must be given to the designers before the faults are pointed out.—EDS.]

A Professional Hobby?

SIRS,—Now that the result of the Coventry Cathedral Competition has proved beyond dispute the fallibility of the system, it seems an opportune moment for the JOURNAL to conduct a vigorous campaign for a new approach to the problem. Since the qualified members of the profession have time only to treat competition work as a hobby, it is hardly surprising that nothing of much moment manifests itself.

The professed intentions of those who organize competitions have been: (1) to ensure that the best possible solution to the problem is obtained, and (2) to enable young members of the profession to have their chance.

The Coventry Cathedral competition has achieved neither of the above and I would propose that, in future, architectural competitions be open to all students, both young and old, and methods be devised to ensure that the winning of a premium may not be a " hallmark of mediocrity."

COLIN OATES

Norwich

A Battersea Bungle?

SIR,—May I draw your attention to the following which appeared in an article in " Tribune " of July 27, entitled " Bungling at Battersea," under the signature of Ian Mikardo, M.P. After referring to the two reports by accountants on the expenditure on the Festival Gardens which had conveyed the impression that a substantial proportion of the extra cost of the Gardens was due to many of the workers on the site being slackers, or " subversive elements," Ian Mikardo pointed out that when Joint Production Committees were set up a great contribution was made by the workers' representatives to improving and speeding up the work of construction.

He continued: " In particular, it was the workers' representatives who saw most clearly how the completion of the work was being held up by the architects. Very often drawings and instructions for a job arrived on the site after the job was finished; in fact, a large bunch of drawings were delivered after the Gardens were finished and open to the public. In the latter days of the construction, there were many occasions when, just as a building was being completed, the architects sent along fresh instructions, involving alterations or additions to it. The JPC, on the motion of the workers' representatives, unanimously protested against this practice at their meetings on February 15, 21, March 15, and April 3; they might have saved their breath to cool their concrete. At one stage in the construction of the Children's Zoo there was a period of five weeks in which no operation was completed without an alteration. Halfway through making the Zoo cage it was found that they were building it to the wrong drawings. If this had been done by the Coal Board instead of by a private contractor, it would have filled the columns of the *Daily Mail* for a week."

If these facts are not as stated, the architectural profession should answer these statements which cast a serious reflection on its efficiency; if true, how many cases of this kind are occurring up and down the country?

PLANNER

COVENTRY CATHEDRAL

Second Approval for New Design

Basil Spence's design for a new cathedral at Coventry has passed its second and most important stage of approval. All thirty members of the cathedral council which were present at a meeting on September 19, voted in favour of the assessors' selection. The council is to request the cathedral reconstruction committee, the first body to pass the plans, to proceed with the work. Formal approval of the design has also to be obtained from the joint council of the Coventry Cathedral Christian Service Centre, the Coventry City Council and the RFAC.

COID

Design Congress, 1951

On Wednesday and Thursday of last week a Design Congress, organized by the COID, was held at the Royal College of Art. The chairman of the Congress Committee was John Gloag. The Congress was attended by prominent industrialists from many countries and the central subject for discussion was " Design Policy as a Responsibility of High Level Management." Members of the Congress divided into three groups to read, listen to, and discuss papers which referred to their own and related industries. Speaking on furniture and related industrial productions were Rudolf Kladeren, vice-president of A. B. Nordiska Kompaniet, Sweden; Soren Hansen of Fritz Hansens Eftfl, Denmark; Ian Henderson of Story & Co. Ltd.; Dr. Harold Hartley of Radiation Ltd.; and W. H. Gispen of Gispen's Fabriek voor Metaalbewerking N.V., Holland.

BUILDING RESEARCH CONGRESS, 1951

This week's issue of the JOURNAL *is devoted to our reports from the Building Research Congress* 1951. *We publish, in the following pages, summaries of the authors' introductory remarks and the ensuing discussions on papers which appeared in the two previous issues of the* JOURNAL. *These are followed by summaries of many of the other papers and reports of the discussions which followed them, including the three planning symposiums, which took place at the RIBA, on hospitals, factories and schools.* (*Illustrations by courtesy of the Building Research Congress,* 1951 *; photographs of personalities at the Congress by a* JOURNAL *staff photographer.*)

STRUCTURE : Mechanisation and Cost

Six papers, summaries of which appeared in the JOURNAL for September 13, 1951. Extracts from authors' introductory remarks and reports of the discussions which followed each paper.

The Congress was opened by Lord Samuel. Welcoming the 1,200 members who gathered in the Great Hall of the Institution of Civil Engineers, he said that science, theoretical and applied, had given the architect, the builder, the engineer and the craftsman, new technologies, and that this was an age of many new technical problems, demanding continual scientific research to handle them. "This Congress," he said, "will help to make known everywhere the results of research already attained, and to encourage the pursuit of new achievements." Lord Samuel also read a message of welcome from the King, and his speech was followed by an address by the Director of Building Research, DSIR—F. M. Lea.

R. FITZMAURICE (*UK*), *adviser to the Building Research Station, Watford, who, at the first session of Division I, gave a general review.*

Mr. Fitzmaurice expressed the view that the research institutions had an indispensable part to play in developing methods of applying research to the problems of the Industry but that, even if they developed the methods, no real progress would be possible until the Industry itself took advantage of the research methods which had been worked out.

DISCUSSION

John Laing (*UK*), *building and engineering contractor,* pointed out that one of the difficulties of the building, as opposed to the public works contracting, industry, was that the operations of fixing do not lend themselves to mechanization. The general concensus of opinion was that output in building with an efficient bonus system was about equal to what it was pre-war, but that there was not the scope for mechanization that there was in public works. Mr. Laing called particular attention to the difficulty of obtaining finality in designs and specifications under present conditions. He was certain that if finality could be obtained at an early stage this would do a very great deal to improve output.

Dr. J. P. Mazure (*Netherlands*), *Professor at the Technical University of Delft,* was strongly of the opinion that Mr. Fitzmaurice's generalization that productivity in building falls below civil engineering was false. He was a strong supporter of traditional methods

of construction aided by modern methods of organization.

Dr. L. J. Murdock (*UK*), *a scientist working for a building contractor,* agreed that there was a need for better educational facilities in technology, but questioned whether the mechanization of certain operations was truly an instrument for increasing productivity because when all ancillary labour in the manufacture and servicing of machinery was taken into account the net gain in productivity might not be great. Dr. Murdock thought that the larger organizations in building were acutely conscious of the need for higher standards of organization in the building industry.

A. V. Jennings (*Australia*), a master builder, was convinced that there must be more intimate collaboration between the designer and the contractor, and far more candour and realism in the forms of contract.

Dr. J. P. MAZURE (*Netherlands*), *Professor at the Technical University of Delft, whose paper was entitled "The European Approach to New Methods of House Construction."*

In developing the main points of his paper, Dr. Mazure noted particularly an important effect of non-traditional building in his country. It had been shown that in order to succeed with non-traditional housing sites a higher standard of organization was necessary. It was remarkable that this higher standard of site organization had tended, as a result, to be carried into the field of traditional building.

DISCUSSION

R. Fitzmaurice noted that, from the figures quoted by Dr. Mazure, new techniques were at a disadvantage in the Netherlands owing to the remarkably high efficiency of the traditional industry there. The normal man/hours, as reported by Dr. Mazure, were less than half the figures for a traditional house here. Dr. Mazure had called attention to the effect on housing costs of the high cost of materials. Mr. Fitzmaurice felt that there was great scope for research in reducing the quantities of materials required. Quality control and better manufacturing processes would enable us to reduce factors of safety from their present absurdly high levels.

E. Levin (*UK*), scientific research worker, remarked that new methods of construction were now competing successfully on an equal footing with traditional methods of building in the UK. He felt that the essential factor was to incorporate the finishings in the element of the shell.

C. O. CHRISTENSON (*USA*), *of the Federal Housing Administration whose paper was entitled "Present Typical Small Dwelling Construction in the USA.*

In the absence of Mr. Christenson, **Mr. Jennings** (*Australia*), a builder from Victoria, introduced his paper. He remarked that he was convinced that there was an urgent need to bring the professional man—the architect—into the building organization for any large scale development. He felt that this would result in a more realistic approach to design and a higher standard of professional ethics in the building organization in itself. Mr. Jennings laid particular stress on the fact that if new methods and prefabrication are to be successful it is indispensable that they should not stop at the factory, but that the same organization should continue the work and accept the responsibility for field direction.

DISCUSSION

Dr. Leggatt (*Canada*), director of research, pointed out that, owing to the ready availability of timber in Canada, 80 per cent. of small dwellings are built of this material. The ratio of labour to materials is quite different in Canada from what it is in Europe and over a large part of the United States. Dr. Leggatt laid special emphasis on the importance of a good Code of Standards for building, and he thought that modular co-ordination must be developed.

A. MARINI (*France*), *Director of the Centre Scientifique et Technique du Batiment, Paris, who in his paper noted the recent trends in construction techniques in France.*

In introducing his paper Mr. Marini remarked that perhaps the most profitable line of development at present to be found in France was the incorporation of external and internal finishes in heavy prefabricated shell components. These even included joinery and metal components. One of the reasons for progress of this kind was that the larger firms in building and public works had completed their programme of public works development and were looking for an outlet for their skill and enterprise in building.

DISCUSSION

Mr. Michel, architect, remarked that, in his opinion, changes of technique were inevitable on account of external forces imposed on the Industry. He gave as examples the ever-increasing need to conserve fuel and to economize in the use of timber, and stated that it was quite useless to pretend that we should be able to continue in the old way.

N. S. FARROW (*UK*), *building contractor, and* **J. F. EDEN** (*UK*), *research engineer, whose joint paper was entitled "Recent Research into the Use of Mechanical Aids for Building."*

In introducing the paper, Mr. Farrow remarked that in his opinion there was a big field for research into the reasons for the difference between the approach to mechanization in different countries. He remarked that it was extremely difficult to mechanize craft operations in building, but pointed out that in the building of a pair of houses 1,200 tons of material (with double handling) had to be moved. There was plenty of scope here for research into mechanization.

DISCUSSION

H. E. Comben, *builder,* stressed the importance of the development of small machines for the small builder, and asked whether it were better for development to take the form of large machines, which the small builder would have to hire for short periods as required, or whether small multi-purpose machines should be designed, which the small man would be able to keep for himself and use continuously.

Mr. Broadbent, *production engineer,* remarked on the importance of a continuous and steady load for the crane. He thought that the packaging of bricks, tiles, etc., by manufacturers was an essential development in order that they might be handled on the building site by cranes or similar devices.

Kirby Laing, *builder,* called attention to the fact that the appropriate use of mechanical aids was not a haphazard process. Their use should be planned if they were to be effective. He thought that the immediate monetary advantage of a machine was not the only criterion. The overall savings in time were extremely important, and in themselves might be sufficient justification for the use of a machine.

G. SHINDLER (*Switzerland*), *architect, whose paper was entitled "The Influence of the Industrialisation of Building and Prefabrication on Design and Drawing Office Procedure."*

In Mr. Schindler's absence, due to illness, his paper was introduced by R. Fitzmaurice, who said that he felt that Mr. Schindler's contribution was very important owing to the fact that he had had special experience of new building technique in four different countries. Mr. Schindler had emphasized in his paper the fact that there is no reason why buildings erected by new techniques should be ugly or monotonous, and he had shown why this was so.

DISCUSSION

Professor Webster, *contractor,* remarked that in the long run new techniques might result ultimately in a simplification in the architect's drawing office technique. He felt that the æsthetic limitations imposed by new building techniques could be very much exaggerated, and agreed with Mr. Schindler that there was no need whatever for pessimism on this account.

STRUCTURE : Theoretical Design

Six papers, each summarized in last week's issue of the JOURNAL, were given on this subject. The first, a general review, was by G. Wastlund (Sweden). This was followed by papers on concrete by H. Granholm (Sweden), F. G. Thomas (UK), A. R. Collins (UK) and A. L. L. Baker (UK) ; on steelwork and welding by G. Winter (USA), F. A. Partridge (UK), J. F. Baker (UK) and F. Campus (Belgium) ; on timber by P. O. Reece (UK) and C. F. Morrison (Canada) and on light alloys by A. G. Pugsley (UK). The following are extracts from the discussions which followed these papers.

CONCRETE

K. Hajnal-Konyi : With regard to the risk of failure, there is one important consideration which, as far as I can see, has not yet received sufficient attention, namely, the way in which a structure fails, or, in other words, the question of warning before failure. There are three types of failure. There is the structure which fails suddenly without any warning ; there is the structure where a substantial increase in deformation takes place on the maximum load being reached, but the load is still maintained, and there is a gradual failure with ample warning of the approaching danger. It is obvious that, all other conditions being equal, the failure risk is much greater in the first case than it is in the third. In reinforced concrete beams the first type of failure occurs only if the tensile reinforcement either is excessive and is not balanced by an adequate amount of compressive reinforcement, or is so weak that the beam fails at the first crack. The second is typical of beams reinforced with steel having a natural yield point. I consider that a designer should aim at the third. This aim can be achieved only if the reinforcement has no definite yield point.

K. Hajnal-Konyi (UK), consulting engineer in private practice, mainly concerned with shell - concrete and the use of high tensile steel.

Henry J. Cowan : I am interested in the strength of statically indeterminate reinforced concrete structures, and two investigations are at present in progress at the University of Sheffield.

We have found that the strains at low loads agreed very well with the values calculated from the elastic theory, but the collapse load was much higher than we had anticipated. I was therefore very interested in Professor Granholm's line of fracture theory, and, on applying it we found that it gave results which agreed much better with our experimental values than those obtained by the usual method.

Replying to the discussion **Prof. Granholm** said: Mr. Cowan pointed out that in frame tests there was, in certain cases, a very great cracking that was very objectionable. If you wish to avoid cracking you have to use bars with a good bond and you have to distribute the bars over the entire section.

H. Granholm (Sweden), Professor of Building Technics, Chalmers University of Technology, Gothenburg.

Mr. Thomas, *replying to the discussion,* said: I was interested in Mr. Cowan's remarks about statically indeterminate structures. I agree that the term " plasticity " ought not to be applied to the behaviour of concrete near failure, but I do not know what term we should use for it.

STEELWORK AND WELDING

Speakers were about equally divided in favour of and against the main issue, namely, whether to base steelwork design on the method of plastic analysis developed by Professor Baker and the Steel Structural Research Committee, or whether to use conventional methods of elastic analysis. For the benefit of our readers who may not be aware of this controversy, the point to remember is that, like many innovations, the new method of plastic design is probably very much closer related to what actually happens in steel frame building than the theories which are conventionally used for steelwork design based on mathematical conception of elasticity. The disadvantage is that the new method is, firstly, unfamiliar and, secondly, in some cases, rather more complicated for computation in engineers' offices.

On the important question raised by Professor Baker at the end of his introduction, that a more rational determination of design loads was much overdue, there was strong support from Dr. Mazure of Delft University and from Guthlac Wilson, consulting engineer.

Professor Wilbur made the point that for impulsive loads, as. for example, the sort of thing that arises in design of structures for Civil Defence and the like, the plastic method of analysis is almost the only way.

Guthlac Wilson, in dealing with the importance of reviewing design loadings, made the excellent point that design loads for floors may be in need of review owing to the widespread use of stacker trucks which are now practically ubiquitous.

TIMBER

G. A. Gardiner, *Chief Structural Engineer, Ministry of Works :* What Mr. Reece said about the most suitable material for a structure is very important. As we say facetiously in the Ministry, if necessary we shall build in stale bread. Reinforced concrete is not quite as strong as ordinary fir and pre-stressed concrete has about the strength of English oak.

There is a great need for young engineers to study timber more thoroughly. I have carried out experiments with nail joints in timber and have found them very efficient. We found that the nail must have five-eights of its length into the timber to which the other timber is connected. I understand that the art of clenching nails is practically lost.

Mr. Reece, *replying to the discussion :* Nails are the most economical means of assembling timber structures. The difficulty is that we are too accustomed to using nails. If you give a workman a blueprint showing the spacing of the nails to be used he thinks it is red tape and government interference with his job and he does not take any notice of it. Glues will probably be the ultimate solution for connected joints.

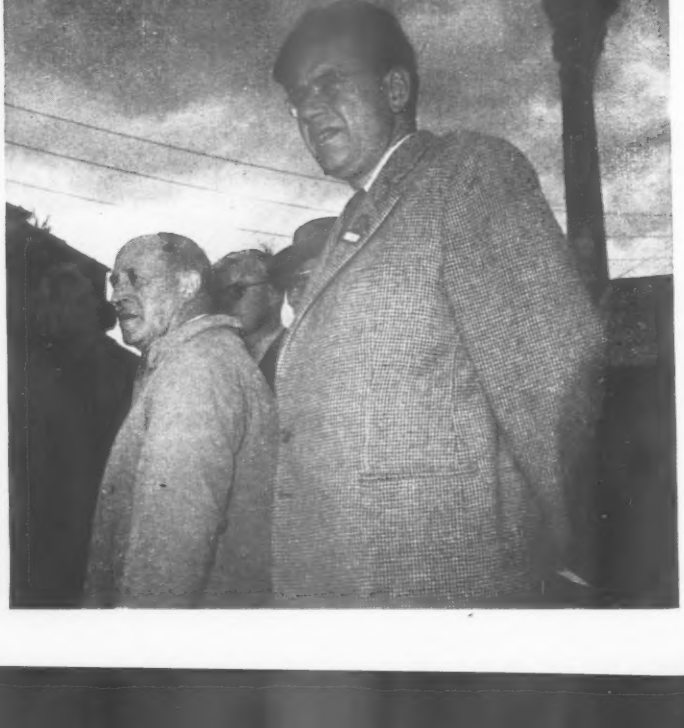
In talking about structural engineering in timber we are talking about a new industry. It will take a long time to get the necessary knowledge, technique and craftsmanship which are so essential.

LIGHT ALLOYS

Professor Pugsley, *replying to discussion :* It is natural for research work in any field to endeavour to look ahead to foresee troubles and find ways of overcoming them before they occur in practice. In the light alloy field that has been particularly the tradition because of its early beginnings in connection with aircraft. In so far as it is possible, the light alloy industry will always be well advised to look ahead in the building field also.

SOCIAL EVENTS : RECEPTION AND VISIT

Of the two receptions given for overseas delegates to the Building Research Congress, that given by the London Master Builders' Association, at the Savoy, on September 12, was the first. It was attended by 490 delegates. Top right, L. H. Walker (Trinidad) being received by D. F. Cox (president, LMBA) and his wife. Above left, Stephen Hudson (president NFBTE), D. E. Woodbine Parish (senior vice-president LMBA) and F. F. S. Hearder (director NFBTE). Above right, K. Alsop, organizing secretary of the congress. 48 delegates visited the Sevenoaks Brick Works Ltd. and saw sand-lime and clay stock bricks being made. Bottom left, Basil Jones (director) with delegates A. G. Disch (Norway) extreme left and D. Mastes (UK) next to him. Below left, A. Rossi (UK) and below right, P. Haller (Switzerland), nearest the camera.



The Introductory paper to Division 2 (Building Materials), by Dr. T. W. Parker, Deputy Director of Building Research, BRS, Watford, was printed in full in last week's issue of the JOURNAL. *From the numerous papers in this Division, we have selected those dealing with Burnt Clay Products, Stone, Timber.*

MATERIALS : General Trends in Research

Discussion on Dr. Parker's paper and extracts from his reply to the discussion.

DISCUSSION

T. G. W. Boxall (*UK*), *Director of Research for manufacture of bricks :* I think the building material manufacturer should carry out fundamental research into the properties and qualities of his raw material. Another contribution which I think can be made towards the solution of the problem of cost lies in the reduction and control of the variability of our product. Dr. Parker was, I think, a little pessimistic about the impact that a reduction in the cost of building materials could have on the total cost of building. If control and reduction of variability are the aim of the manufacturer, he should then be able not only to reduce his costs at works but to supply the architect, the builder, the engineer or the designer with more useful information about the properties of the material and thus enable the designer to design in a more rational manner.

Ian Langlands (*Australia*), *Commonwealth Building Research Section :* Dr. Parker has drawn attention to the need for the development of reliable tests which can be used in a specification and which are simple and cheap. Our experience in Australia has very much reinforced his plea. In preparing our Australian Standard Specifications we usually use the British and/or American Standards as a basis. We need local specifications because our conditions are a little different. We find very frequently that both manufacturers and users want to simplify still further, both in kind and in number, the tests required by the overseas specifications. We on the technical side of these committees try to resist that, but we have to face the fact that there is a very real trend in that direction, on the score both of costs and of the time required to do the specification tests. It is exceedingly difficult to devise simple and reliable tests which will give you what you want, and that is particularly so in the case of durability. When you have such tests, it is necessary to ensure that you do not forget the limitations of those tests and the reasons why they are incorporated in the specification.

Dr. Parker, in replying to the discussion, said : I do not think it is always easy to devise a test which can be done in a bucket or by simple gauges, and so on, and which will in fact reflect what will happen to a material which may be in a building for a hundred years or which may have to be in juxtaposition with something that will affect it chemically or physically. It is clear, however, that such tests would be useful, and I am glad to hear from Mr. Boxall that this simplicity, this extension of scientific testing and control, this attempt to reduce variability, is likely to be achieved without increasing the cost to the user of the material. It is true that building materials as a whole are extremely variable products, and the production of more uniform products will be for the good of the finished building.

Dr. T. W. Parker (UK), Deputy Director of Building Research, Building Research Station, Watford, who gave the general introduction.

MATERIALS : Burnt Clay Products

A combined summary of three papers, one by W. Noble and E. Rowden on Recent Developments in the Manufacture of Burnt Clay Products in Great Britain, one by Dr. J. W. Ludowici on Recent Developments in the Manufacture of Burnt Clay Products in Europe and one by Dr. N. Davey on Research in Great Britain on the Performance of Burnt Clay Products in Structures, and its Influence on Practice. The summary is followed by a report of the discussion which ensued.

W. NOBLE (*UK*), *British Ceramic Research Association.*
E. ROWDEN (*UK*), *British Ceramic Research Association.*
J. W. LUDOWICI (*Germany*), *Manufacturer.*
N. DAVEY (*UK*), *Building Research Station.*

The significance of fired clay products for modern building has been to a great extent overshadowed by steel and reinforced concrete construction. On the building site we find that, whilst the use of concrete is facilitated by a whole range of modern tools of high output, bricks are still laid by methods and with tools that have hardly changed in thousands of years. Traditional methods misuse human beings as transport and lifting tools. This must be changed. Either the bricklayer should work on a moving scaffold, being supplied with bricks at working level by a conveyor and with mortar by an extrusion machine, or brickwork should be prefabricated at the works. The weight of prefabricated units should not be limited to what can be handled by one or two men, but might amount to seven tons or more, provided that suitable transport vehicles and lifting equipment are available.

Rational building also demands standardisation and modular planning. For example, mathematical considerations, based on the functions of the angles, dictate the standardisation of three roof pitches (16° 47′, 31° 5′, and 50° 20′) which permit the vertical and horizontal components of the dimensions of roofing elements to correspond with those of the walling units.

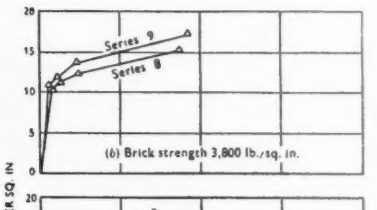
The British clay industry includes more than 1,000 works making building bricks of all types, roofing tiles, floor quarries, land drains, hollow blocks, chimney pots, flower pots, tile fittings and a wide variety of salt-glazed ware and accessories. Some works have a long traditional background but many are of modern origin and outputs vary over an extremely wide range. In an industry of this type progress is measured by the extent to which modernisation has taken place in the older works, by the improved methods, equipment and processes introduced in new works, by the way in which

output has increased and by the extent to which efficiency in the use of labour and of fuel has improved.

PROGRESS IN GREAT BRITAIN

Traditional manual methods of winning and removing overburden have, in many quarries, given way to mechanical scrapers (for where the overburden is soft; these are particularly efficient), dragline excavators, walking draglines and power shovels. These can achieve a state of affairs where as little as 0·08 man-hours are required per ton of material handled. Similar improvements have taken place with regard to methods of haulage and increasing use is being made of the more flexible types of equipment, such as dumpers and electric, petrol and diesel locomotives and trucks.

Clay is now usually prepared by grinding, mixing and tempering, although with some clays and shales weathering is still required. Much use is being made of gyratory crushers



and hammer mills and these have undergone many improvements in recent years.

High-speed rolls and the de-airing extrusion process are used largely for salt-glazed pipes, roof tiles and quarries (particularly the former). The advantages of de-airing have been less apparent in the manufacture of wire-cut bricks; it has, however, been introduced into the manufacture of semi-dry press products.

Hot floor dryers are still used mainly for drying tiles, quarries and salt-glazed ware and to some extent for drying bricks made by the wire-cut process. At certain works hack and other open-air drying methods still persist. There has, however, been considerable development in the use of tunnel and chamber dryers in which increasing attention has been given to obtaining fast rates of drying with humidity and temperature control. During recent years some attention has been given to infra-red and high frequency drying. These latter methods have been used successfully in other industries and drying times have been reduced by as much as 90 to 96 per cent.

Developments in the firing processes used in the industry have included: the gradual replacement of intermittent kilns by continuous kilns; the increased use of mechanical feeders on top-fired continuous kilns; the introduction of mechanical methods for stoking intermittent kilns; the more extensive utilization of waste heat from kilns of all types; and recent progress towards mechanising certain of the setting and drawing operations.

The technical outlook of the industry has tended to expand during recent years. Research, education and training facilities are being developed and progress in these directions is reflected in the wider scope of the literature dealing with the industry and its problems. Clay resources are being surveyed and detailed studies are being made of the raw materials available, of their drying and firing requirements and of the properties of the finished products. Investigations are being carried out on the fundamental properties of clays, on the influence of the constituent clay minerals and on the effect of impurities. Detailed studies are also being made of the manufacturing processes and of methods for increasing efficiency in the use of labour and of fuel.

WORK AT THE BRS WATFORD

Research at the BRS on the structural efficiency of brickwork is carried out under the following headings: strength and stability, resistance to moisture penetration, resistance to frost attack, weathering and corrosion, thermal insulation, sound insulation, fire resistance, and resistance to cracking.

Particular attention is paid to methods of using bricks which depart from traditional practice. Among conclusions already reached are:

1. That there is no appreciable advantage to be gained when using bricks with a crushing strength of up to 3,000 lb. per sq. in., by bedding them in a mortar much stronger than 1,000 lb. per sq. in. It has been recommended, therefore, that for low strength bricks (up to 1,500 lb. per sq. in.) mortar should be composed of 1 part Portland cement, 2 parts hydrated lime and 9 parts of sand (by volume). See graphs on left.
2. That "butterfly" wall ties for cavity brickwork should not be smaller in diameter than 12 s.w.g.
3. That, when a low percentage of reinforcing steel is used there is no important difference between the strength of reinforced concrete and reinforced brick beams of similar cross section.
4. That 11-in. cavity brickwork can attain Grade A (6 hours) of fire resistance.

Much research on other burnt clay products, such as hollow clay block and floor and roofing tiles, is also in progress.

DISCUSSION

Introducing his joint paper with W. Noble, **E. Rowden** mentioned that, with regard to the use of waste heat, in some works all the drying was now done by waste heat, and that this was particularly important where the fuel used was electricity. **W. Noble** told of an interesting development in the mechanization of the Industry. Apparently, some small works were finding it worthwhile having all their clay dug during the summer months by outside contract with a firm having highly efficient equipment.

Dr. Ludowici *showed some interesting lantern slides illustrating novel uses of burnt clay products, including a shell of interlocking tiles constructed entirely without reinforcing rods, prestressed rafters, barrel vaults, slabs (approx. 8 ft. × 4 ft.) of clay blocks held in a tubular steel frame, and a machine for bricklaying which provides a continuous supply of bricks (or blocks) and mortar (through a hose) to the bricklayers hand.*

He described a rotating laboratory designed to eliminate the influence of sun and rain. One wall was built traditionally; the other three, of the construction being tested.

Introducing the third of this group of papers, **N. Davey** explained how in the design of steel structures it might be possible to take into account the stiffening effect of brick panels, with a considerable saving in steel. Tests had shown how great was the stiffening effect.

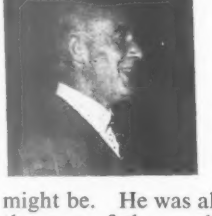
G. H. Whiting, *fletton brick manufacturer*, expressed the hope that we would soon be able to classify clays by their minerological content instead of by their locality. He said that since the fletton brick was a cheap brick his firm could not afford to spend a lot on research. But they made the best use they could of the equipment they had, so as to make it as near as possible one hundred per cent. efficient. They were unable to try out new ideas without thorough statistical research.

He said that they had found terrific differences in the speed of drying in different parts of the kiln and they were asking the question, " Was the Hoffman kiln as operated at present the best type of kiln for their purpose ? " They thought that much more work might be done on the design of kilns. This might lead to the development of a new type of kiln or to modifying existing types.

B. Butterworth, *research worker*, pointed out that there was one important development in the design of kilns which should be mentioned. That was the construction of the continuous chamber kiln over a series of brick arches. This allowed a free circulation of air underneath, for without this no amount of insulation over the soil would prevent over-heating and temperatures of 80° C. had been found 12 ft. below ground level.

He thought that the European industry had most to teach us in the design of tiles. Our staple product was still a primitive rectangular slab ; even the simple single lap pattern was invented in the 1890's.

T. G. W. Boxall, *director of research for a manufacturer of bricks*, said that he had studied Dr. Ludowici's paper with much interest but would like to know how expensive the prestressed rafters



T. G. W. Boxall (UK), Director of Research for a brick company, who also spoke on general trends in research on building materials.

might be. He was also concerned with the cost of the machine for " laying " bricks. Moving scaffolding had been successfully developed in this country

but the cost of equipment to raise scaffolding had been found so expensive as to be impracticable. Prefabricated brickwork had also given a lot of trouble without saving money or man-hours. He wanted to know whether the accelerated weathering test which Dr. Ludowici had mentioned gave good correlation with natural tests. He thought that in designing roofs it was important to consider architectural as well as mathematical aspects.

In replying to the discussion **Dr. Ludowici** said that prestressed rafters gave a 20 per cent. saving in cost and weight over concrete. He said that the economy of using the brick-laying machine would depend largely on the question of transport; although it did not cut out the man himself, it would increase his output ten times. With regard to the freezing test, he said that it gave the best correlation between the natural state and the laboratory so far achieved.

B. Butterworth, *research worker,* described work that was now being carried out in this country. It had long been realised that sulphate attack was one of the most serious dangers. Water running down a wall carried with it sulphates from the bricks which decomposed the mortar. Hence the importance of cills, DPC's, etc. If the sulphate content was too high bricks should not be used under conditions of severe exposure such as parapets. Mr. Butterworth said that we did not know what was the critical percentage but experiments (*of which he showed lantern slides*) were now in progress.

MATERIALS : Stone

Summaries of two papers, one by A. Marini and G. Demarre, on The Use of Stone in France, and one by H. F. Broughton on Stone Housing in Great Britain. The summaries are followed by a report of the discussion which ensued.

A. MARINI (*France*), *Director, Centre Scientifique et Technique du Batiment Paris.*

G. DEMARRE (*France*), *Centre Scientifique et Technique du Batiment, Paris.*

In France, stone is regarded as the traditional material *par excellence* for high quality construction. Stone is plentiful in many districts, and has consequently been used extensively not only for the monuments of which French architecture is justly proud, but also for the construction of dwellings—whether blocks of flats on important city streets, or private residences in suburbs and villages.

The preference shown for this material by architects and by property owners, who look for a long period of amortization for their capital investment, is justified by the remarkable properties of building stone when carefully selected and used; richness of appearance, adaptability to various decorative schemes, strength, durability, etc.

On the other hand, the cost of dressed stone masonry is undoubtedly higher than that of other traditional materials such as brick, rubble, building blocks and concrete or metal panels on a structural frame. Efforts are, therefore, being made to reduce the cost of masonry.

The first step in this direction was the publication in 1945 of French Standard Specification B. 10-001, for standardization permits the rational organization of production.

Then there have been great improvements in methods of quarrying.

Modernization has consisted in the change-over from hand-tools to machines, classifiable in two groups:—

1. Machines, usually pneumatic, functioning by impact as did the old quarrying tools.
2. Drilling machines with hard cutters, usually of tungsten carbide.

Underground, pneumatic or electric cutters are used. In open quarries ordinary pneumatic drills can be used vertically in the line of the cut.

Sawing too, which in the past was always done by hand, is now highly mechanized. Wire saws, consisting of endless cables on which are threaded carbide cutters, band saws, consisting of three steel ribbons with tungsten carbide teeth, and circular saws (for cutting sandstone) are all in use. Lighter types of machine, suitable for use on the building site are also available.

These saws can cut hard stone at the rate of 1 m. super per hour, *i.e.*, 60 times the speed of a handsaw. Soft stone can be cut at the rate of 1 m. super per minute.

The modernization of quarrying is not merely a matter of using new excavators and saws, handling, transport and organization and layout are equally important. A rough estimate for hand carrying and stacking would be between 3 cu. m. and 6 cu. m. per man per hour. At Bonneuil-en-Valois, by using a special truck and an electric roller conveyor, this figure has been raised to 20 cu. m. At the quarry at Saint-Leu-d'Esserent, productivity has increased sevenfold as a result of using modern equipment.

Since 1946 the production of stone in France has doubled, and it is hoped that the price will drop sufficiently for masonry to be considered not solely as a luxury material. Already a number of dwellings are being built in blitzed towns with walls of quarry faced stone, including a low-rent housing estate at Nanterre, which will include 623 dwellings.

H. F. BROUGHTON (*UK*), *Building Research Station, Watford.*

Until the middle of the nineteenth century and the advent of the railway, economic considerations dictated the use of stone, where indigenous, for domestic and other building. The method and form of construction were largely controlled by the type of stone available, but whatever the type there was usually a plentiful supply merely for the "winning." Consequently, thick solid stone walls became traditional, although each locality had its individual treatment and character. With the development of cheap transport, other materials, particularly brick, became competitive in stone areas. Building economy began to change and the balance in favour of brick has increased progressively to the present day. Furthermore, the effect on the national economy of two world wars has done much to widen the cost difference between brick and stone houses, so that today the high cost of stone housing is almost prohibitive in most areas.

The need for more houses and the preservation of local characteristics at the same time is a serious problem in the stone areas. During the last 30 years attempts have been made to reduce the cost difference between brick and stone houses, by lowering ceilings and eaves, and by planning in terraces. It is possible also to reduce the thickness of solid walls in sheltered positions and to use cavity walling (the inner skin consisting of material other than stone) in exposed positions.

Increased mechanization of quarry processes and the use of the carborundum and the impregnated diamond saw, can also reduce the cost of masonry. While it is not suggested that the cost difference between brick and stone houses can be eliminated, it is considered that in many stone areas the existing cost difference could be reduced appreciably, without seriously detracting from local character, if architects, housing authorities and quarrymasters would co-operate and if stone dressing were standardized and simplified.

DISCUSSION

Dr. Bonnell, *of the Building Research Station,* pointed out that we had to differentiate between sentiment and fact in this problem. The continued use of stone depended upon standardization and mechanized production and were we prepared to accept the aesthetic losses thereby entailed? Broughton had pointed out that there was a vicious circle: high cost of production resulted in low demand for stone; low demand entailed low production; and low production brought high costs. How was this vicious circle to be broken?

Mr. Rice, *of the Building Research Station,* pointed out that very large quantities of stone were used in France and that this had enabled mass production techniques to come into being.

Mr. Orchard, *of Edinburgh,* deplored the falling off of the natural stone industry in Scotland. Many quarries with a nationwide reputation were working no longer. Also, Scotland abounded in harder stones which did not lend themselves to mechanized production. Mr. Orchard hoped that the use of stone in public buildings would be retained, using full craft technique in order to train masons in hewing as well

would continue to be worked by masons on the building site.

Mr. Reed, *Brixton School of Building*, made the point that as things were today there would be no appreciable force of stone masons available in 10 or 20 years and that naturally as stone would continue to be used it would have to take the form of block laying of a mass produced product. He mentioned the cost of self bedding stones and asked whether they were surviving.

Mr. Reiner, *of Israel*, remarked that though stone had been the " King " of building materials it was now dethroned. He made the point that a good architect should be able to make a beautiful building in any material. Economic factors had compelled us to use stone in the most economic way possible, and Mr. Reiner thought that the future of stone was in the stone block, mechanically produced.

H. A. Adams, *President of the Amalgamated Union of Building Trade Workers*, instanced the great pleasure to be derived by all and sundry from looking at the craftsmanship of present and past generations of masons. He felt that masons might have to take to untraditional methods if stone work was to survive. He felt that colour and texture of natural stone would always find their place even if elaboration by carved detail had to be sacrificed. He mentioned that the Union and employers were working hard to foster apprenticeship in masonry and felt that these papers were bound to do good.

Summarizing, **R. Fitzmaurice** considered that the concensus of the papers had made the point that the survival of natural stone in building depended on the use of mechanized extraction and production.

MATERIALS : Timber Technology

From this section, one paper has been selected by F. H. Armstrong on the Abrasion of Timber Flooring. It is summarised below and followed by a report on the discussion on timber technology.

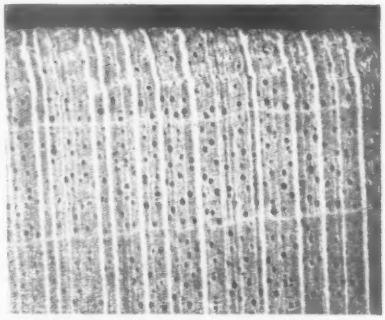
F. H. ARMSTRONG *(UK), of the Forest Products Research Laboratory, Princes Risborough, gave a paper on the resistance to wear of timber flooring.*

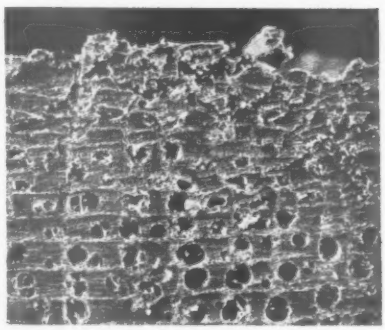
In the testing of wood for resistance to abrasion, a laboratory test should simulate normal conditions of service. The older methods of abrasion testing have proved unsuitable in this respect. But a new machine, developed at the Forest Products Research Laboratory, Princes Risborough, has achieved a considerable measure of success. Explanatory tests indicated clearly that the mode of failure of both softwoods and hardwoods, resembles very closely that obtained under service conditions.

A metal planing machine was adapted for the purpose. It has two abrading tools; one a stamper, with 12 cheese-headed studs, to impart impact blow, and the other a rubber, consisting of a pad of wire-wound Ferrodo brakelining, to abrade the surface and rub away loose fibres.

High density has been, in the past, taken as an index of good wearing qualities. The new methods of testing have shown, however, that not all woods with high density rank equally high in resistance to wear. A number of other factors have an important bearing on both the qualitative and the quantitative aspects of the problem.

Recent analyses of the wear of both softwoods and hardwoods have explained the phenomenon of surface breakdown and have also indicated the real influence of density on resistance to wear. From the qualitative point of view, and so far as softwoods are concerned, the important factor influencing behaviour under traffic is that of the density of the constituent tissues. Where there is a distinctive ring growth structure, as in the case of north temperate zone conifers, the density differential of springwood and summerwood is considerable and is reflected in the initial compression of the tracheids of the former. The extent of the compression depends on the resistance offered by the tracheids to lateral compression. In the springwood with its thin-walled elements this will be low as compared with that of the thicker-walled tracheids in the summerwood and rupture will ultimately occur. In the rift-sawn material the breakdown leads to the ridging or serrated appearance so frequently seen, and in the flat-sawn stock to a " shelling-out " of the softwood tissue. The characteristic ridging of rift-sawn stock will be much less pronounced when the percentage of summerwood in the growth is high. It will be appreciated that wide bands of dense summerwood give a large measure of protection to the comparatively narrow





bands of less dense springwood, and in consequence internal compression of tracheids is small. On the other hand, if the percentage of summerwood is very small, or practically non-existent, as in the softwoods of the south temperate zone, there is no significant density differential and wear is more uniform. The density of the wood tissue as a whole is, in such a case, the principal factor influencing both qualitative and quantitative wear. The photo-micrographs show the development of surface wear and breakdown in two hardwoods; the first, small-pored; the second, ring-porous.

DISCUSSION

B. Alwyn Jay, *deputy director of the Timber Development Association*, said that Mr. Armstrong's work on timber flooring was of great scientific value and of practical use to the building industry. His experiments were novel and the results, particularly of the wearing qualities of woods of the same weight, were interesting.

F. W. Vigers, *of Vigers Bros., Ltd.*, said that there was one point which he queried ; that Burma teak flat sawn should have been classed in the same way as Douglas fir flat sawn. He did not agree with this classification and he did not think Douglas fir should be used for flooring.

Mr. Vigers added that Burma teak flat sawn had been used in the Festival Hall staircase and 12,000 people a day had passed over it and there was no sign that it was cracking or failing in any way. Yet he knew a case where Douglas fir was used in a building at Euston and it had failed after only a short time in use.

Of Mr. Knight's paper " Plywood as a Building Material," **A. H. Scroggs,** *of J. Gliksten & Son, Ltd.*, said that it was an interesting study on a material with interesting possibilities. People who had never before demanded plywood were now doing so and consumption in many countries was growing rapidly.

R. Shalon Friedland, *from Israel*, spoke of the use of plywood as shuttering for concrete, stating that 40 experiments had been carried out in her country.

Addressing Mr. Richardson's paper, " The Preservation of Timber," **R. G. Bennett,** *former director of contracts, Post Office*, said that the general interest in timber preservatives was growing, and the economic lesson—the comparison between the initial cost of wood and the high cost of replacement—was being driven home.

WORKING DETAIL

VENTILATION: 1

HOOD OVER COOKING APPLIANCES: SCHOOL AT CHIGWELL

H. Conolly, Architect to the Essex County Council.

The sides of the hood are panels of corrugated transparent plastic sheeting held in metal sections and the top is lined with aluminium sheeting on fibreboard.

Architects' Journal 27.9.51

WORKING DETAIL **VENTILATION: 1**

HOOD OVER COOKING APPLIANCES: SCHOOL AT CHIGWELL

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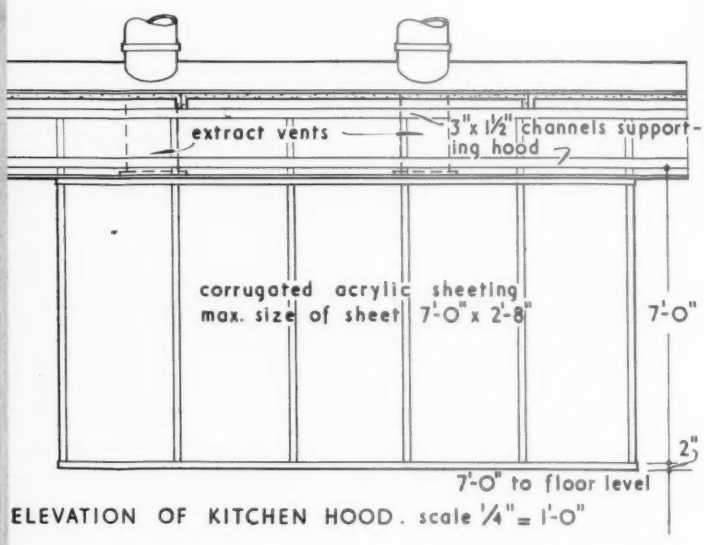
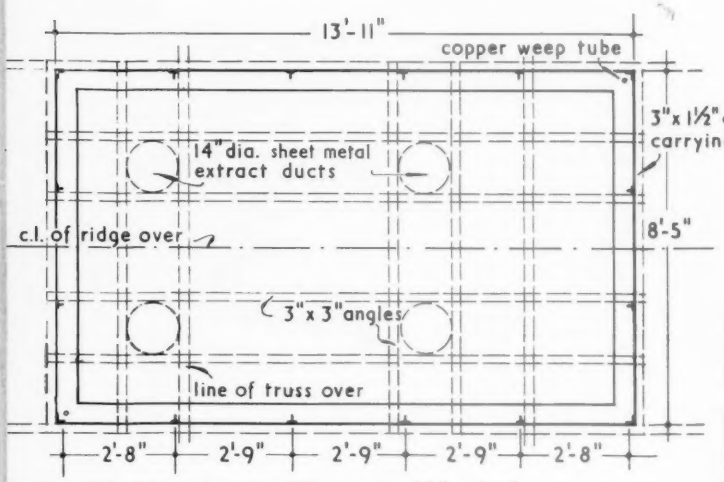
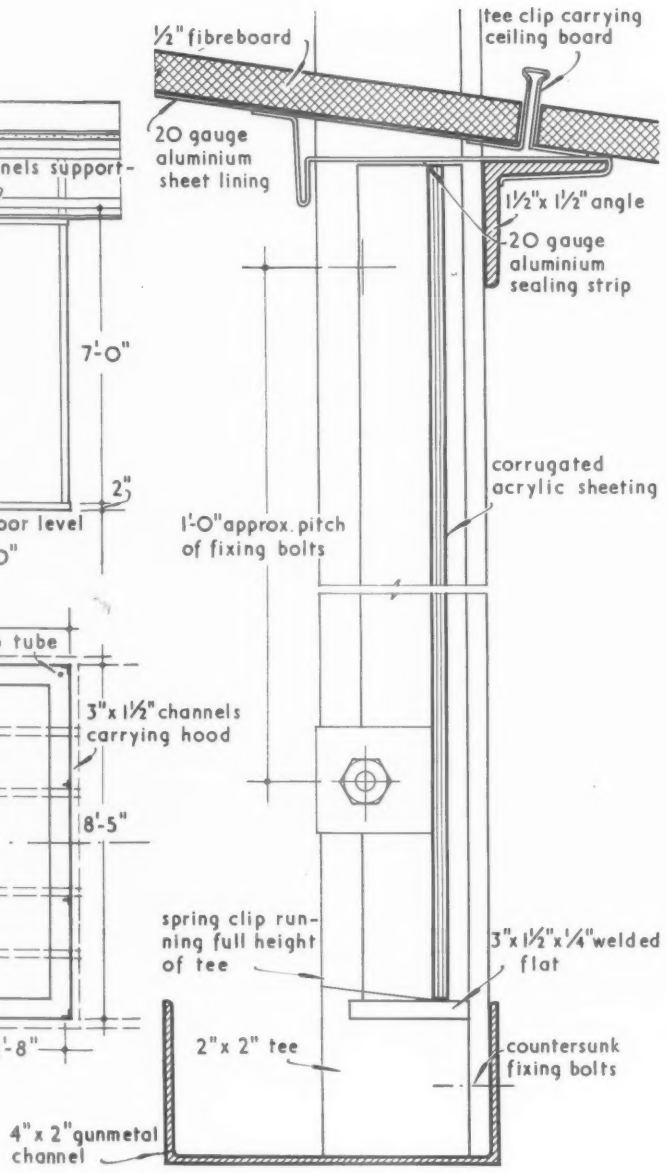


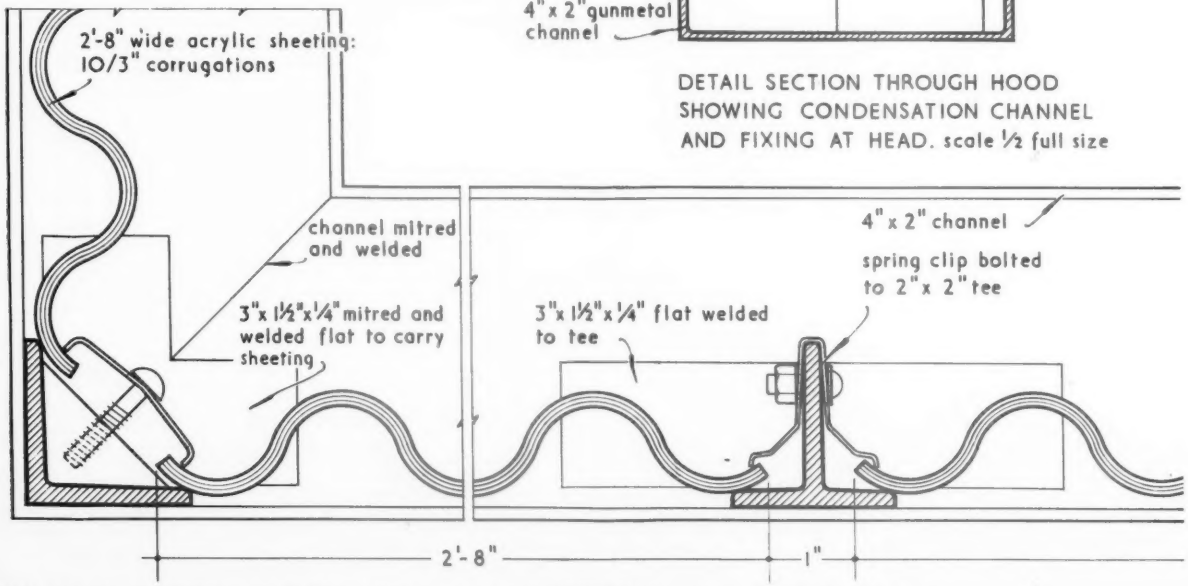
ELEVATION OF KITCHEN HOOD. scale ¼"= 1'-0"



PLAN OF KITCHEN HOOD. scale ¼"= 1'-0"



DETAIL SECTION THROUGH HOOD SHOWING CONDENSATION CHANNEL AND FIXING AT HEAD. scale ½ full size



DETAIL PLAN SHOWING CORNER ANGLE AND INTERMEDIATE TEE. scale ½ full size

WORKING DETAIL **WINDOWS: 7**

WINDOWS WITH FLOWER BOXES: WATERLOO STATION GATE, SOUTH BANK EXHIBITION

John Burnet, Tait and Partners, architects: Freeman, Fox and Partners, consulting engineers.

The flower boxes have perforated aluminium fronts and each is flanked on either side by a panel of double aluminium sheeting filled with heat insulating material.

WORKING DETAIL **WINDOWS: 7**

WINDOWS WITH FLOWER BOXES: WATERLOO STATION GATE, SOUTH BANK EXHIBITION

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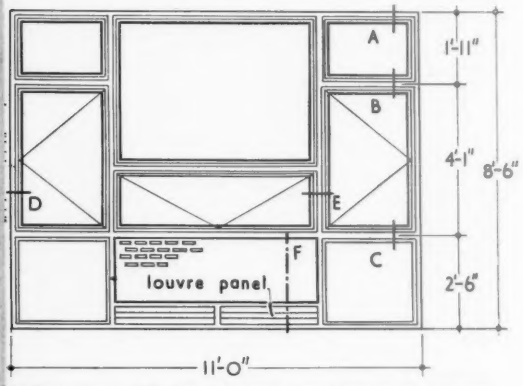
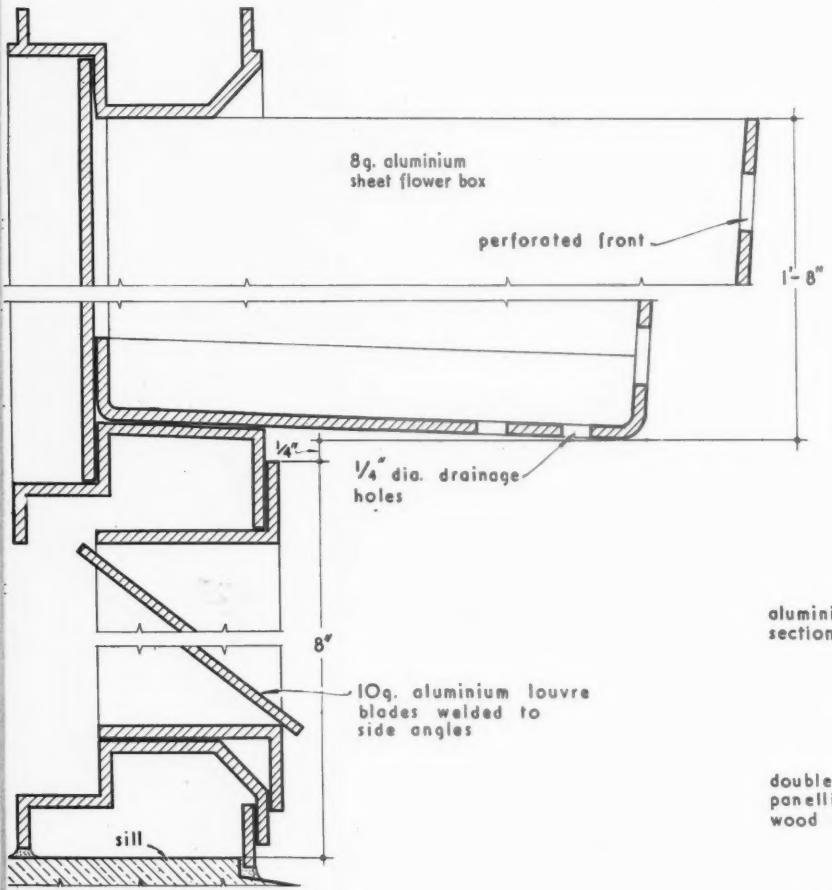
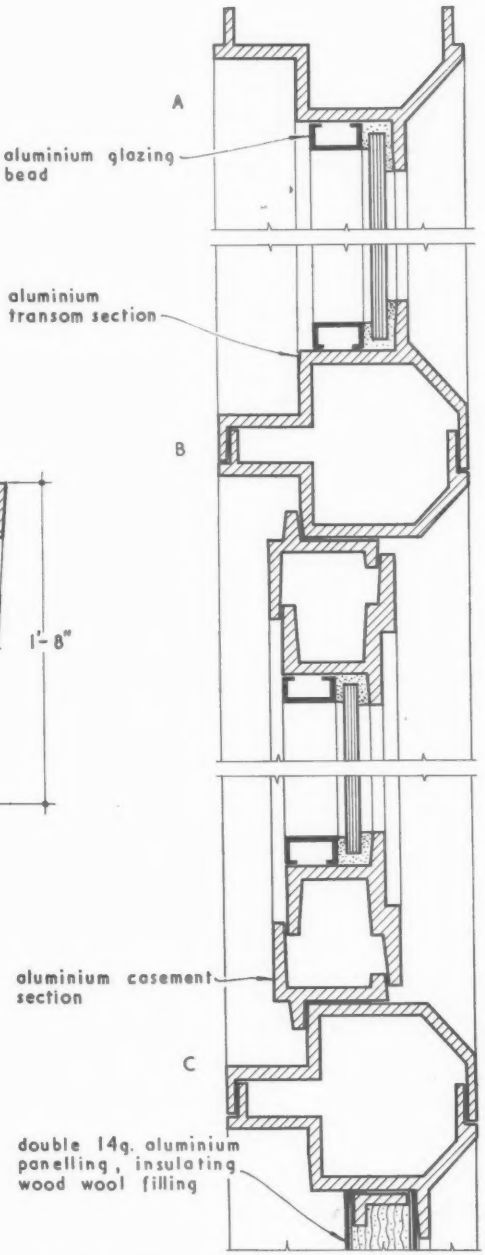


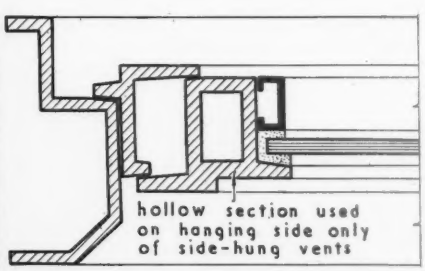
ELEVATION OF ALUMINIUM COMPOSITE WINDOW.



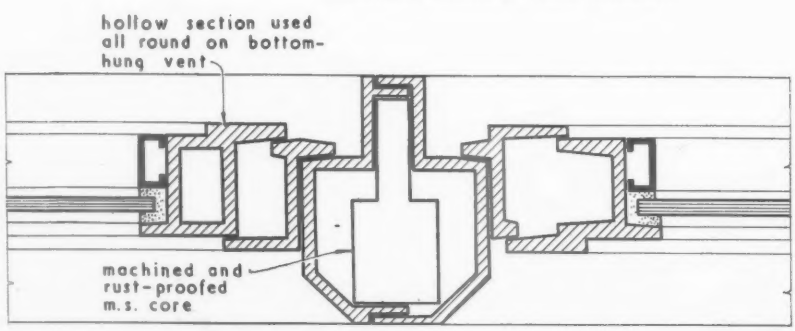
SECTION THRO' FLOWER BOX AT F.
scale ½ full size



VERTICAL SECTION THRO' WINDOW



PLAN THRO' JAMB AT D.



PLAN THRO' MULLION AT E. scale ½ full size

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SOCIAL EVENTS: RECEPTION AND DINNER

Over 450 overseas members accepted the London County Council's invitation to a reception on September 14. Of the many that were present we picture, above left, H. J. Spiwak (UK), P. B. Guha and M. V. Gavandi (India); above right, M. and Mme. Fahmy (Egypt); top right, Mme Hansen, Mme. Ronstrom (Sweden) and M. H. H. Hansen (Denmark). Delegates attended a dinner at the Connaught Rooms on September 17. Below, right, Alister MacDonald, chairman of the organizing committee, who proposed the toast to the overseas guests, and below left, Professor Georg Wastlund (Sweden) who was one of the persons to reply.

DESIGN: Acoustics

Summary of the paper by Professor Vern O. Knudsen on the Acoustics of Large Auditoria, followed by a report of the discussion which ensued.

VERN O. KNUDSEN

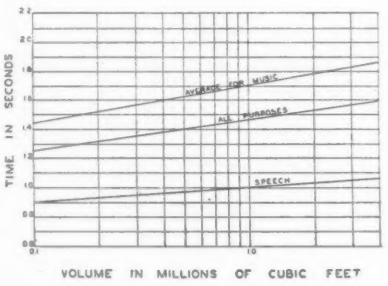
(*USA*) *Dean of the Graduate Division, University of California.*

As would be expected, defects in multi-purpose halls with volumes greater than ½ million cu. ft. are due mainly to the large space enclosed and the large unbroken wall and ceiling surfaces—especially when these are reflective or concave. These obstacles may, at times, be unavoidable, but volumes tending towards the ratio of 200 cu. ft. per seat can be obtained at design stage by using balconies and low ceilings. Large dimensions emphasize such defects as inadequate sound level, long delayed reflections (echoes) and excessive reverberation. Large unbroken surfaces, especially concave, usually produce uneven distribution of sound and, even when the foregoing and other structural defects have been eliminated, unamplified speech and musical performances by small groups of musicians are found inadequate and a high-quality sound amplification system becomes necessary.

The requirements for good acoustics in these halls also include those commonly known for small halls. Outside noise, and noise from ventilation and other equipment, should not exceed 35 db. Rear walls and balcony fronts are usually highly absorbent and, since loud-speakers are directed towards the rear of the auditorium, it is desirable to eliminate concave shapes. These surfaces should be broken up to reflect the sound so that it is diverged and diffused. Air absorption is high, so that it becomes impossible to attain optimum reverberation times for frequencies above 2,000 c/s. Therefore, materials are selected which are decreasingly absorptive at this level and the relative humidity of the air is kept above 50 per cent.

Large choruses, bands and orchestras may not require sound amplification, but a rear shell is necessary, designed to partially surround the performers and of such shape and size as will blend the sound throughout the hall, as well as enabling the performers to hear each other.

When amplification is resorted to, it is essential that microphones, amplifiers and loudspeakers of the highest quality are used, and, if drama or opera is to be performed, a stereophonic system should be used to maintain a spacial effect.

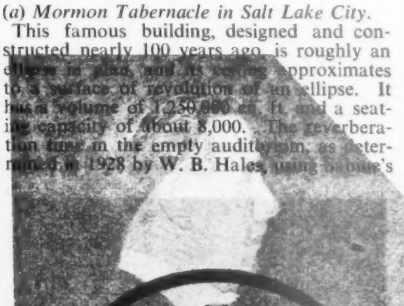


Graph showing optimum reverberation time at 512 c/s as function of volume.

TYPICAL LARGE AUDITORIA IN THE USA

(a) Mormon Tabernacle in Salt Lake City.

This famous building, designed and constructed nearly 100 years ago, is roughly an ellipse in plan, and its ceiling approximates to a surface of revolution of an ellipse. It has a volume of 1,250,000 cu. ft. and a seating capacity of about 8,000. The reverberation time in the empty auditorium, as determined in 1928 by W. B. Hales, using Sabine's organ pipe method, was about 9 sec. at 200 to 500 c/c, and diminished at both lower and higher frequencies. With an audience of 6,000 or more in the tabernacle, the reverberation time *vs.* frequency characteristic conforms satisfactorily to the optimum for music. But the acoustical fame of this building results primarily from the elliptical shape of its smooth, reflective (lime plaster) ceiling. This is beneficial for the reinforcement of unamplified speech for listeners in the rear balcony, because the pulpit and the central portion of the rear balcony are close to the principal foci of the elliptical ceiling. This peculiar shape is responsible also for troublesome echoes and a non-uniform distribution of sound throughout the seating area. However, the present sound-amplification system is of high quality and provides a good, clear level of speech.



The Mormon Tabernacle in Salt Lake City.

(b) Kansas City Auditorium.

This is a stadium or arena type of auditorium, rectangular in plan (250 ft. wide. and 270 ft. long), seating 14,000. The reverberation is controlled by means of acoustical plaster walls (upper portions) and ceiling, and heavily upholstered chairs; it conforms well to the optimum reverberation time for small, medium or capacity audiences. There is more diffusion of sound in this auditorium than there is in the Salt Lake Tabernacle, and this probably is advantageous for music, but the quality of speech is determined almost wholly by the sound-amplification system and by the appropriate suppression of noise and reverberation.

(c) National Orange Show Exhibit Building, San Bernardino, California.

This exhibition hall, rectangular in plan (180 ft. wide and 240 ft. long), with exposed truss ceiling, a volume of 2,300,000 cu. ft., a reverberation time of more than 9 sec., and a small stage on one side, was converted into a fairly satisfactory auditorium by the addition of 32,000 sq. ft. of 2-in. thick glass-silk insulation. Surfaces which gave rise to echoes or troublesome reflections of the directed sound from the loud-speakers were especially selected for the absorptive treatment. The result has been good diffusion of sound, and, with an audience of 5,000 or more, a reverberation time of less than 2.0 sec. at 512 c/s.

(d) Atlantic City Convention Hall.

This huge auditorium covers a plot 350 ft. by 650 ft., has a ceiling height of 135 ft., and seats 40,000 persons. Reverberation is reduced to a suitable value by treatment of the entire ceiling with a highly absorptive acoustical tile. A high quality sound-amplification system makes it possible for speakers to be heard satisfactorily in all parts of the auditorium.

DISCUSSION

P. H. Parkin, *BRS*, gave a brief résumé of experiences with the Royal Festival Hall, covering the elimination of external noise, and, rather unexpectedly, claimed to be unique as he could still tell when underground trains were passing beneath the building. Later he said that without resorting to amplification the maximum size had been reached on the main floor of the Hall, but considered that the gallery could have been deeper.

C. M. Harris (*USA*) explained that there were few halls of over half a million cubic feet and thought that present data were incomplete, but he supported the flattening of Knudsen's O.R.T. curve for speech at its upper limits and stressed the fact that R.T. was by no means the sole criterion for the assessment of hearing conditions.

E. Meyer (*Germany*) briefly explained how the acoustics of the Hamburg and Hanover Opera Houses and the Hall of the University of Bonn had recently been improved by the addition of large movable reflectors, mounted behind acoustically transparent screens flanking the stage in the two former cases and exposed at the rear and sides of the latter. **Hope Bagenal** (*UK*) later commented upon these " mirrors " and said that they should not only be large but massive ; all too frequently, the fullest advantage was not being taken of the near and upper surfaces round the platform or stage.

H. R. Humphreys, *BBC*, suggested that under-gallery conditions could be improved by acoustic interconnection with the upper space, by applying the open riser stair " cliche " to the balcony risers, where perhaps 20 per cent. open area would be sufficient. To achieve this, Hope Bagenal thought that the practical difficulties were insuperable. During the session several speakers paid tribute to the successful team work that had taken place to produce the satisfactory conditions we now had in the Festival Hall.

W. Allen, *BRS*, expressed doubts about the future of the splayed or fan-shaped auditorium and felt that further research into the field of associated physical data was required, together with orchestra study and the co-operation of composers, conductors and musicians.

In closing the meeting, **R. H. Matthew,** *Architect to the London County Council*, pleaded for general simplification of acoustic expressions as the harassed architect of today was genuinely interested in current acoustic theory and research, but was too often baffled by the scientists' technical language.

DESIGN: The Effect of Thermal Capacity

Summary of the paper by J. C. Weston and A. W. Pratt on The Thermal Capacity of Buildings, followed by a report of the discussion which ensued.

A. W. PRATT (*U.K.*), *of the Building Research Station, Watford, who, together with J. C. Weston, gave a paper on the thermal capacity of buildings.*

J. C. WESTON (*UK*), *of the Building Research Station, Watford.*

While the thermal capacity of buildings is not a dominant factor in design, it does in certain circumstances have important practical effects. For example, the advantage of night shut down depends largely on the capacity of the building, while comfortable living conditions in the tropics are frequently secured by judicious use of structures of differing thermal capacity. Heavy structures may be employed for rooms in use during the day, and light structures for bedrooms.

Thermal capacity depends on a number of physical properties of materials, but a method has been devised by which the effects of thermal capacity when heating is intermittent can be calculated. This would doubtless be the work of a heating engineer, but the use of linings of low thermal capacity and conductivity has long been recognised as a method of increasing the rate of heating up of a room; such materials as wood panelling and fibreboard being particularly suitable for this purpose. (For any heating period there is, however, a critical thickness for the lining material. If it is thinner than this heat will flow into the base material.)

Direct experimental evidence of the value of linings in increasing the rate of heating of rooms has been provided by several workers, but the advantages are less marked when the source of heat is an electric radiant fire or a gas fire. It has been possible to reach the same conditions in 1 hour in a lined room as are reached after 6 hours in an unlined room and heat requirements for intermittent heating up to 6 hours have been reduced by as much as 50 per cent. (with electric tubular heaters) when a lining was used.

There can be little doubt of the value of low thermal capacity linings where very intermittent heating for one or two hours is required, but it should be remembered that most of the heat load tends to be more or less continuous, or at any rate spread over many hours. The overall fuel economy that can be achieved by low capacity linings is, therefore, only likely to be substantial in special cases when heat is required for short periods.

The use of linings of highly-reflecting materials, such as aluminium foil, has also been suggested as a method of increasing the rate at which comfort may be achieved in a room; here again, the saving is greater with intermittent than with continuous heating.

With regard to buildings as a whole, the thermal capacity determines whether or not it is economical to shut down heating for an 8-hour period overnight. Estimates of the possible savings vary considerably, but it is suggested that, with a light building, the saving may, theoretically, be as much as 25 per cent.; whereas, with centrally-heated buildings of normal construction, with solid fuel boilers, the saving may only be between 5 and 10 per cent.

An important factor may be characteristics of the boilers at varying loads and this may well determine whether or not night shut-down in any particular building is to be recommended.

DISCUSSION

It was generally agreed that heavy construction could give added comfort in daytime in hot climates, and at night also, where there was a large drop in temperature after nightfall. In the latter circumstances, there could be considerable discomfort where light-weight construction was used. The heavy construction gave back to the house a considerable amount of heat when the temperature fell—a rise of 14° F. between inside and outside had been measured. Where the variation between day and night temperature was small, light construction was better.

A speaker from India recommended that the best construction was to provide outer walls of low retention but high insulation, and heavy inside walls; such a construction could, on a hot day, give a reduction of inside temperature as great as 10° F.

For temperate climates, the general opinion was that light construction should be used where heating was intermittent, and heavy where it was continuous; but **Colonel Newcombe** put in his customary plea for light-weight linings and reflectors and heat only used where it is needed at the time.

It was pointed out that great interest in insulation had come about in the USA as the result of wartime restrictions on heating appliances, due to lack of materials. The Federal Housing Authority specified a maximum heat loss coefficient of 66 BThUs per sq. ft. of floor area, and this is being reduced to 50 BThUs. The heat losses of new construction are no more than half those of pre-war.

DESIGN: The Influence of Daylighting

Summary of the paper by W. A. Allen and J. B. Bickerdike on The Influence of Daylighting Research on the Design and Layout of Buildings, followed by a report of the discussion which ensued.

W. A. ALLEN (*UK*), *of the Building Research Station, Watford, who, together with J. B. Bickerdike, gave a paper on the influence of daylighting research on building layout and design.*

J. B. BICKERDIKE (*UK*), *of the Building Research Station, Watford.*

Originally developed to assist in legal discussion of interference with rights of light, daylight studies, as far as the designer is concerned, are now mainly of value in the prediction of daylighting characteristics in new buildings. This is principally done by the protractor method, which gives a "sky factor" at any point of reference within a room, this factor being a function of the area of sky visible from that point, without, however, making an allowance for orientation or for reflected light, either from external sources or within the room itself.

Methods of making allowance for these variables, which would be expressed as a weighting factor on the "sky factor" itself, are being investigated but, even admitting the limitations of the present system, it has the great merit of being simple to work and of giving tangible expression to characteristics which in themselves are rather nebulous.

In factories, inter-reflection between walls is not a major influence, and as reflections between floor and ceiling are likely to be uniform over the whole area, consideration of the "sky factor" alone will not lead to serious misrepresentation of the actual daylight factor. Again, in the case of schools, as rooms to be compared are of generally similar character, use of the "sky factor" alone, without allowance for reflected light, will give a tolerably accurate assessment of the facts.

In town planning studies, daylight, investigators endorse the use of the cruciform plan for high buildings, permitting maximum penetration of daylight at the lower levels and, as the effect of reflected light will be to increase the values obtained from direct light alone, no major error will result from the consideration of "sky factor" only.

A farther variable factor in the calculations is sky brightness. "Sky factors" assume uniform brightness over the whole sky but in fact there is less at the horizon than at the zenith, which may invalidate the calculations for rooms where the windows are set low in the walls.

Turning from general design to details, modern vision studies have been of great value in showing the most suitable design for windows and glazing bars, where in addition to light distribution within the room an important aim is the reduction of contrast between the glass and its surroundings. This implies careful design of the reveals and glazing bars, and research endorses particularly the traditional Georgian window with its plastered external reveal, deep panelled internal reveal and deep narrow glazing

bars, with light coloured paint, giving a gradual reduction of illumination from the bright exterior to the inner face of the wall.

Such contrasts may be further reduced by lighting a room from two sides, although windows on opposite sides of the room may not necessarily give the best effect.

There is now a swing away from the large glass areas of the modern window as, although the spotty effect due to intermediate piers is eliminated, discomfort glare can result from too large an area of window—hence the *brise soleil*.

Concluding, it may be affirmed that modern daylight studies have now reached the point where they can provide an adequately firm basis for the functional assessment of penetration to demand consideration as a contributory factor in the synthesis of an architectural design.

DISCUSSION

The discussion touched on a number of topics, although all the speakers were in general agreement with the paper.

J. Ratner, *of Israel,* put in a plea for objective thinking by architects rather than the use of ready-made solutions; the design of the Royal Festival Hall had been derived partly from generalisations and partly from research. Conclusions drawn from factories and schools were not necessarily applicable to other types of buildings.

Drawing on his experience in a Mediterranean climate, he said that even when steps were taken to use reflected light rather than direct light, there was still an appreciable intake of heat as well as light. Too much light out of doors gave a feeling of tiredness, in contrast to which a partly darkened interior gave repose.

Concluding, he considered that the scope of research stations should be further broadened and that architectural students should be taught to appreciate the value of lighting research.

J. Pleijel, *of Stockholm,* who had earlier presented a paper on Reflected Daylight and Model Studies, asked whether research workers' findings in this country had been given effect in

G. PLEIJEL *(Sweden), of the Royal Institute of Technology, Stockholm, Sweden, who gave a paper on reflected daylight and model studies.*

Town Planning Regulations, and this was answered by **H. J. Reifenberg,** *engineer,* who said that the LCC had now made effective daylighting a condition of Town Planning approval, and that the MOW had required the findings of the BRS to be implemented in the design of new office buildings. He also felt that there was a need for a single criterion of daylight quality embodying the values of direct light from the sky, reflected light, and penetration.

DESIGN : The Use of Colour

Summary of the paper by F. Birren on The Functional Use of Colour, followed by a report of the discussion which ensued.

F. BIRREN *(USA), of New York*

Faber Birren is a leading authority in the USA on the use of colour in buildings and is well known for his writings on the subject. Whether the author's qualifications will reconcile British architects to accepting fully his thesis is questionable, for the main theme of the paper was that colour must be applied functionally and, moreover, that if it is applied functionally it will be satisfactory in appearance. This may seem to be going too far. Nevertheless, the paper was full of interest and Mr. Birren's explanation of the valuable assistance which correct colour can give to comfort, safety and efficiency, was very convincing.

Perhaps the most important point which he made was that seeing conditions depend not just upon lighting but upon lighting plus colour treatment. It is an indisputable fact that brightness ratios, which of course are largely dependent upon the colour of decorations, are a vital factor in seeing conditions.

The author also raised the interesting subject of colour psychology and is firmly convinced that the type of colour used should be related to the type of occupation. Bright, light, warm colours for action, but cool colours and dim light for sedentary tasks and mental activity.

Case studies were quoted and it is clear that the subject has received most careful study in America. Impressive figures of large scale investigations were quoted to show the real increases in work output and the reduction in accident and illness rates. A safety colour code has been developed and is widely used in industrial plants and is accepted for all shore plants of the US Navy.

DISCUSSION

There was some disagreement as to whether the immediate background to a task, *i.e.,* the working surface itself, should be made the same colour as the task, which avoided contrast, or a complementary colour which would throw the edge into relief, but might make detailed vision of the task rather difficult near the edges.

Robert Wilson, *British Colour Council,* said that even managers could not see their factories as they really were, as they had become used to accepting dirty conditions because they had always been present. A feeling of repose should be aimed at, rather than distraction from the task.

Mr. Wood, *ICI Paints Division,* referring to the safety colour code, said that it had been seized on as a guide to factory decoration, which was not the original intention. He questioned whether such a code was capable of universal application, and in any case no system of distinctive painting could take the place of proper lighting and planning of plant.

Part of a tractor plant before and after colour treatment, the lighting being unchanged. Visibility is greatly improved.

SOCIAL EVENTS: COMBINED SESSION AND COCKTAIL PARTY

The last combined session took place at the Royal Festival Hall. Above right, Professor Matheson, Professor of Engineering, Manchester, giving his impressions of the Congress. Above left, Dr. Alois Kieslinger, Professor of the Technischer Hochschule, Vienna, and Professor Jakob Holmgren (Norway). Below are visitors to an AJ party: right, top, L. H. Marchiafava (Italy) and H. L. Gloag (UK); centre, H. G. Goddard, H. L. Gloag and Mrs. Freyer; bottom, L. H. Pizon (Columbia) (left).

DESIGN SYMPOSIUM: Hospitals

From the symposium on Hospitals we have summarised the paper by Richard Llewelyn Davies on Research into the Functions and Design of Hospitals. The discussion which follows relates to the entire symposium. Other papers were by Mato Erik Molander, of the Central Board on Hospital Planning and Equipment, Stockholm, and Marshall Shaffer, of the United States Public Health Service.

RICHARD LLEWELYN DAVIES (*UK*), *Director and Architect, Investigation into the Functions and Design of Hospitals, London, gave a paper on the research by the Nuffield investigation into the functions and design of hospitals*

It is curious that in a country with a highly-developed State health service there is no State-sponsored research institution for studying hospital planning. In Sweden and the USA, where hospitals are more independent, such institutions do exist. However, the Nuffield Provincial Hospitals Trust decided, in 1949, to sponsor research. Their investigation team consists of a doctor, a nurse, a field-work organizer, an historian, an accountant and an architect. The first questions which the team set out to answer were:

(i) What proportion of patients in hospital can be expected to be bedfast, ambulant or partially ambulant?

(ii) What proportion of patients in hospital should have, for medical reasons, a single room or cubicle?

(iii) What are the requirements for daylight in a ward?

(iv) What is the pattern of nurses' movement about the ward, and how can ward design reduce the distances walked?

(v) What, from the nursing point of view, is the best group of patients to form a unit?

(vi) What is the best size, arrangement and equipment for ancillary rooms?

(vii) What are the limiting factors in bed-spacing?

(viii) How can ward design minimize the risk of cross-infection?

(ix) What accommodation is required in the ward for medical staff?

These studies have all been completed, and full accounts of the more important ones have been, or will be, published.

Much of this research centred around the planning of the ward, for the ward is, undoubtedly, the most complex problem in the hospital. Nowhere else are there so many interlocking and often confusing requirements to be satisfied. On the other hand, there has been more thought devoted to ward planning and ward organization than to any other part of the hospital, with the exception, perhaps, of the operating theatre. The earliest hospitals consisted of little else but wards, and many of the questions much discussed today were already being thought and written about in the 18th century.

As early as 1752, John Pringle, a military surgeon, wrote, "the wards to be 15 ft. to the ceilings . . . and no room to contain more than 8 beds." Florence Nightingale, however, saw the practical problems more acutely. In 1859 she wrote:

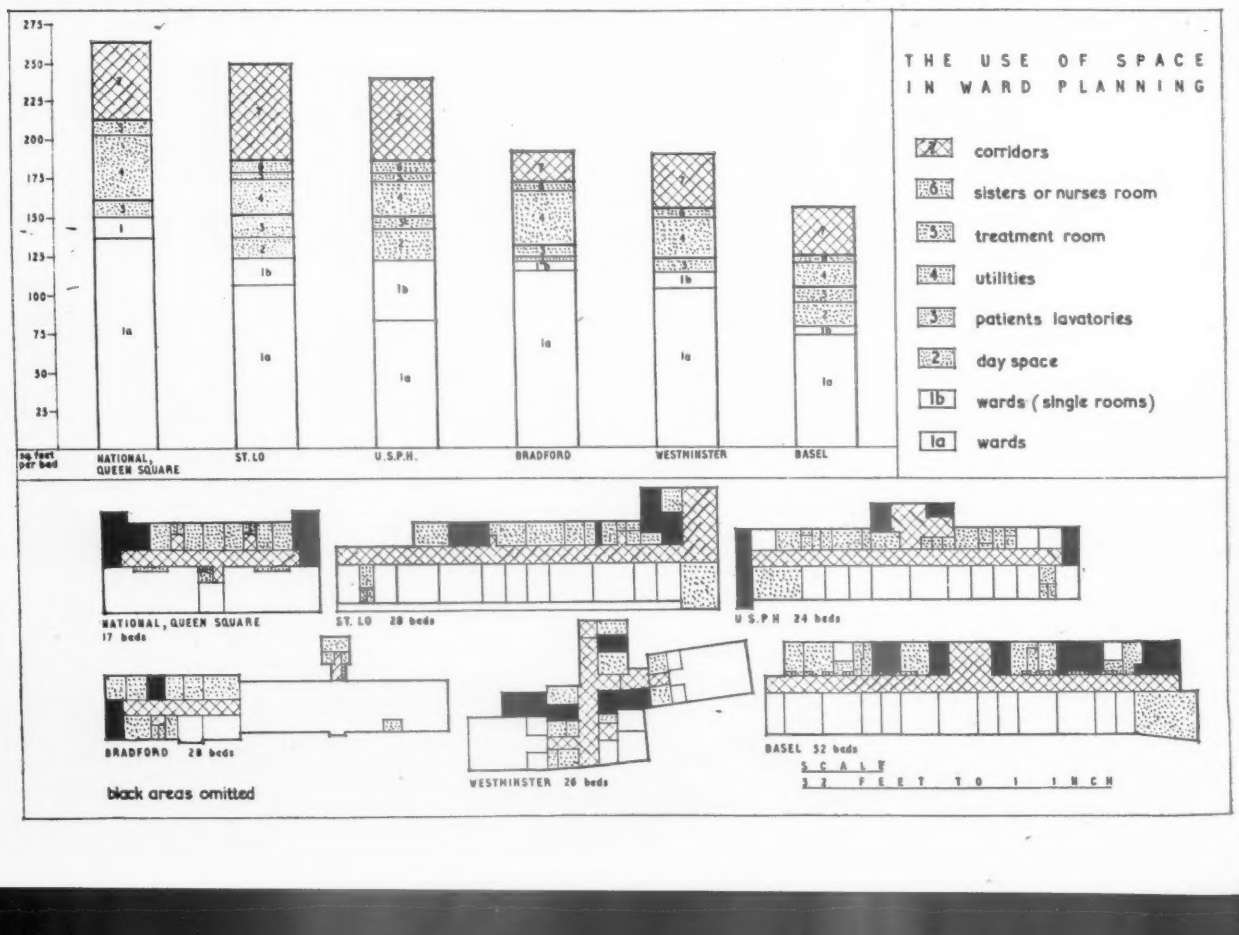
"The best size of wards for ensuring the two conditions of health, and facility for administration and discipline is 20 to 30 sick. Wards smaller than 20 beds multiply both the attendance unnecessarily, and the corners unfavourably for ventilation. Wards larger than 32 beds are undesirable because they require a greater height of ceiling, and are hence more costly in construction and difficult to ventilate."

WARD PLANNING

One method by which different arrangements can be compared is by analysing the space used for various purposes in each. The diagram below shows six modern wards analysed in this way.

Leaving aside, at first, the two extremes, Basle and the National Hospital, there are two corridor schemes, and two with large wards; the two with corridors using appreciably more space per bed. They require a total space of about 250 sq. ft. per bed, as against 200 sq. ft. for the open wards, a difference of about 25 per cent.

If the area for single rooms is included in the total, the diagram shows that there is little difference between the four wards in space allotted to the bed areas. If the single rooms are excluded, the corridor plans



require less space per bed than do the open wards. This is natural, as in the latter case the centre area of the ward has to serve to some extent as a general circulation space, and must therefore be fairly roomy. The single rooms are inevitably heavy users of space, and it is the relatively large number of these rooms in the corridor plans which brings their total bedroom area up to that of the open wards.

The remaining area, excluding corridor space, is devoted to service and ancillary rooms, and is slightly larger for the corridor-type plans. These service areas are probably not dependent on which type of plan is being used, and the differences shown on the diagram reflect the fact that the corridor types are the more recent, and often include a large day space, a treatment room and more patients' lavatories, as compared with the older types. There has actually been a slight decrease in the area devoted to ward kitchen, sluice room and duty room, which are shown grouped under the heading "Utilities."

Finally, the circulation or corridor areas may be compared. Here, it appears that there is a decided advantage for the open type of ward, the corridor space at St. Lo being over three times that at Bradford, and amounting to over 60 sq. ft. per bed.

The Basle ward, omitted from the discussion up to now, is an example of the corridor plan which requires less total space than any of the other wards examined. The bedroom area is strikingly less than in any of the other schemes because the beds are three deep, and the spacing is very much closer than normal practice in this country or the USA. As the diagrams show space per bed to enable fair comparisons to be made between wards with different numbers of beds, any reduction in bed spacing increases the number of beds in the unit, and thus affects the figures for all the areas shown.

The ward from the National Hospital for Nervous Diseases shows the opposite phenomenon. Here the beds are spaced exceptionally far apart, resulting in a total bedroom area considerably above the normal. Other areas are correspondingly great, and the total area is the highest shown.

PRACTICAL EXPERIMENT

Much research remains to be done and, in fact, this work can never be completed for our hospital service is continually changing and developing; with every advance in medicine and every change in social structure, new problems, and new solutions, emerge. However, certain broad conclusions have been reached.

Briefly, it would appear that there are certain important advantages in preserving for those patients not acutely ill, many of whom will be ambulant, something of the character of the traditional English ward. Further, in the interest of economy, the ward building should be thick and compact, with services placed centrally in relation to the group of beds they serve.

DISCUSSION

William Allen, *Building Research Station*, supporting the paper, said: There is a remarkable similarity between the approach of Mr. Davies's organization to a planning problem and the classical standard form of a scientific experiment. It is remarkable that we have reached a point in modern architectural studies where we are using the standard experimental forms of classical research and turning them with such strict parallels to a straightforward architectural problem. We shall see a great deal more of this in future because it is the only way that the profession of architects can attain unquestioned competence in its duties to the public in general and its clients in particular.

Captain Shaffer : It is high time we architects took a look at the methodology of industrial engineering. Our training in the past has been too close to something remote and magnificent.

Marshall Shaffer (USA), Senior Engineer (R), United States Public Health Service, introducing his paper.

Captain J. E. Stone, *Director-consultant on hospital finance in the Division of Hospital Facilities, King Edward's Hospital Fund :* My view of hospital planning is to start with the patient in the bed, to work from the inside to the outside instead of from the outside to the inside as was the practice before the war. By that means we plan the hospital from the functional point of view—there is the patient, what does he want, who will get it for him, what services does he require ?—rather than from an architectural point of view. Function must be the deciding factor.

K. W. Hamilton, *South Africa*, said : Hospitalisation can be divided into two problems, planning the hospital and also staffing it. It is increasingly difficult to get nurses and we shall have to design our hospitals as much round the nurses as around the patients.

K. W. Hamilton (South Africa), Architects' Branch, Cape Provincial Administration.

Certain sections of hospitals are developing more than others. X-ray diagnostic has probably reached its limit. With the advent of new drugs, the pathological department is coming along by leaps and bounds, and there will also be great advance in deep therapy by means of radio-active isotopes, a field about which there is at present very little information.

DESIGN SYMPOSIUM : Factories

From the symposium on Factories, we have summarised the paper by the architect—Edward D. Mills on Factors Influencing the Design of Industrial Buildings. The discussion which follows relates to the entire symposium. Other papers were by the American architect F. A. Fairbrother and G. P. Barnett (H.M. Chief Inspector of Factories, London).

EDWARD D. MILLS *(UK), architect in private practice, London, gave an introduction to the factors influencing the design of industrial buildings.*

Any major industrial development in Great Britain must have government support. The control of industrial development is under three headings, location, finance and timing. A Board of Trade certificate is required for any factory exceeding 5,000 sq. ft. in area, and the Town and Country Planning Act, 1947, governs the siting of factory buildings. In view of the difficulty of providing suitable factory accommodation in the large towns of this country, factory estates are being planned. These make possible a high standard of communal facilities not otherwise available to small concerns. A well-designed factory estate should include multi-storey flatted factories, complete buildings planned for extension, and space for industrial firms wishing to build large units which can expand as required. Warehouse, office, recreation and welfare facilities can be planned communally.

SITE

The site upon which a factory is to be built will influence its planning and construction. The area of the land available, in relation to the floor area of the buildings to be placed on it, the value of the land, and the possible need for future extension when adjoining land is not available for this purpose, are factors which will partly determine whether the factory should be an extensive single-storey structure, a multi-storey one, or a combination of both. The position of roads, railway main services, and adjoining property, the natural ground levels and orientation will all influence the layout of the buildings on the site, and determine the final relationship of the various units within the factory. The levels of the site and the nature of the subsoil will determine the type of foundations required, and indicate whether the use of basement areas for heating and ventilating plant, storage or machinery is an economic possibility. When extensive piping is required, owing to poor subsoil, this will influence the choice of superstructure; a light structure with large spans and a small

number of supporting columns will result in economies in foundation costs.

PLANNING AND CONSTRUCTION

The planning of a factory should always be based primarily on the production requirements. Although these vary in each industry, all factory buildings should be planned for a regular, unbroken production flow. Multi-storey buildings are, obviously, economical with land, and are also cheaper to heat and ventilate. With the development of high-speed lifts, elevators, hoists and other mechanical conveying systems, processes using light plant or machinery can be readily housed in such structures. The production flow can be planned vertically, so that materials or finished products are transferred by gravity or by mechanical means from floor to floor.

With multi-storey buildings, excessive spans at ground floor level should, unless absolutely necessary, be avoided for the sake of structural economy. On single-storey structures however large spans can be economical, providing there is sufficient repetition of standard bays.

SERVICES

In industries where a considerable variety of services is required for the operation of machinery or process plant, provision must be made for the proper housing of these services. Pipe runs, ventilation trunking, cable ducts, drains and similar services, must be planned in advance, and accessible ducts, of adequate size must be housed within the structure, in positions which will allow for replacement or re-arrangement of individual items of plant with the minimum disturbance to the building or the general manufacturing sequence. In some factories provision must be made for transporting heavy goods. This produces special problems. Special provision must be made in the design of the structural framework to take the additional loads, but as a general rule, machinery and plant should be supported independently of the building structure, to avoid structure-borne vibration.

Great consideration is given in present day factory design to the problems of artificial and natural lighting, heating, ventilation, and cleanliness and the question of colour. All these factors influence the type of materials and the structural system used for the building.

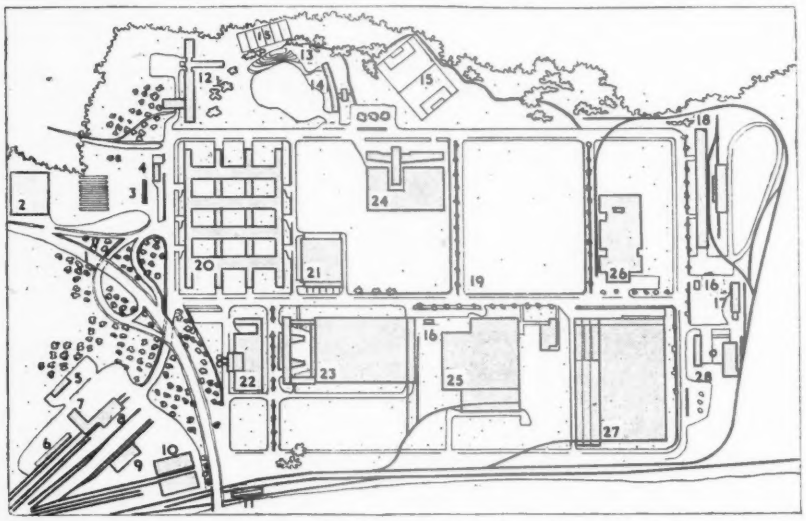
OBSOLESCENCE AND REPLACEMENT

Modern industrial development proceeds at such a rapid pace that the most up-to-date process today may be regarded as obsolete in five years' time; sometimes the demand for the product itself ceases in a comparatively short time. This is a serious problem and many industrialists come to the conclusion that the solution is to use makeshift buildings, which can, in theory, be scrapped after a few years. In practice, these makeshift buildings are so expensive to erect, and the cost of servicing, heating and maintenance so high that they are finally accepted as permanent but unsatisfactory substitutes for proper buildings, costing more and producing less each year.

There are 2 real solutions. Firstly, the construction of properly-designed semi-permanent buildings, with a light structural frame, and standardized wall and floor infilling panels, which can be arranged in a variety of plan forms and, ultimately, dismantled and re-erected elsewhere when their term of use has expired. Secondly, the construction of industrial structures as permanent weatherproof envelopes, housing a flexible, interchangeable and independent framework for the developing process, allowing a complete re-organization of machinery or plant, without interference with the building structure at any time.

The problem of maintenance for industrial buildings is a serious one and the materials used in their construction, if selected properly, can reduce the high cost of maintenance. The question of flooring is of particular importance.

If wet processes are carried out, all floor surfaces must be adequately drained and special care taken to prevent seepage under plant which may cause serious and unsuspected damage to machinery foundations or support to structural members.



Layout plan of industrial estate, Knutsford, Cheshire. (*Architects: Yorke, Rosenberg and Mardall.*)

KEY

1. Administration
2. Sun terrace
3. Sports fields
4. Cafe and shops
5. Bus garage
6. Bus station
7. Petrol pumps
8. Fire station
9. Flatted actory
10. Narrow bank weaving
11. Printing
12. Light alloys
13. Cement products
14. Transformer
15. Boiler house
16. Dry ice
17. Agricultural implements
18. Light engineering
19. Electrical engineering
20. Fresh food
21. Builder's yard
22. Inwards shed
23. Outwards shed
24. Loading bank
25. Crane gantry
26. Fish
27. Goods line
28. Railway station

DISCUSSION

Howard Robertson (*UK*), *architect*: Albert Kahn's firm put factory design on the map as architecture. Much of their factory design was at a higher level than current commercial work.

Howard Robertson (*UK*), *architect in private practice, London, presented a paper by F.A. Fairbrother* (*USA*), *entitled "The Planning of the Factory."*

On the psychological side, I ask myself whether liberality in height might be conducive to comfort and well being and also greater progress in eliminating clutter in design, as evidenced in steel roofs and so on. Beauty of basic form and its effect in connection with day and artificial lighting seems to lag behind the study of lighting itself. Reflection from internal form offers possibilities in the same manner as reflection from external surfaces.

My reaction to the little I have seen of American factories for industry is a slight sense of disappointment with their internal design in comparison with their achievement in design for such buildings as laboratories and special process buildings.

W. E. Taylor, *Director of Research, American Institute of Architects*, supporting the paper: The question of the relation of the site to the labour supply is subject to a great deal of discussion in our country among and between planners and industrialists. Industrialists say that they are expected to take a great gamble in putting their plant where they do not know that there will be a supply of labour. There is a vicious circle when industry goes to a place where there is labour and more labour comes there to join the industry. How can we break the cycle and get a working combination of all the elements, including the services? You have accomplished that in your satellite and garden cities.

Developments in the disposal of factory wastes, including radio-active wastes, the shielding of radio-active apparatus and the cleaning of walls and floors and work surfaces contaminated by radio-active materials must be studied.

Where trading estates find themselves near housing estates they must try to foresee what their noise sources will be and deal with them because our new legal aid scheme will enable humble sufferers from noise nuisance to bring injunctions against offenders much more easily than they used to be able to do.

Michael Powers, *supporting Edward Mills's paper:* One of the most important things for the architect to do

is to stress to his client that it is the quality of his brief which makes the architect competent to approach the problem satisfactorily. Though the situation is constantly improving there is still a good deal of ignorance in the industrial world as to the contribution that the architect should be able to make to factory planning. Unless the architect is properly briefed it is impossible for him to make any contribution of much value at all. It is important in the very early stages to draw together a team, led by the architect and including the management, both administrative and works, structural engineers, plant engineers, heating and ventilating and electrical engineers, and possibly others.

There seems to be no reason why a factory and its surroundings should not be a positive contribution to the area in which the factory is being designed in the same way as a market square or a church was in olden days provided that the architect can persuade the planning team that not only the external appearance of the building but the whole treatment of the site is a vital matter to the neighbourhood.

A. L. Brentwood, *of Australia:* We regard the welfare of the people in a factory as being quite inseparable from

A. L. Brentwood (Australia), of the Department of Labour and National Service, Melbourne.

their efficiency. We feel that if the design of factories promotes welfare, health and safety, the workers are so much more efficient. We try to achieve our objectives through the architect because he is the man who can very largely influence the design of factory buildings. We are trying to break down the tendency of industrialists to want a Queen Anne front and a Mary Ann back. There are too many factories with imposing facades but very poor working premises at the back. That is gradually disappearing but not quickly enough.

Many architects and clients like to spend a lot of money on chromium and tiling in the amenities. That is often a waste of money. If money is allocated for this purpose it ought to be spent functionally. The architect ought to do what he can to economize in expenditure on amenities by ensuring that his design is properly thought out and that there is no extravagance on space.

G. A. Gardiner *(UK), Chief Structural Engineer, MOW:* We use such light construction today that many of the

G. A. Gardiner (UK), of the Ministry of Works.

troubles that develop are entirely due to the lack of substance. It would be an exceedingly good thing if all building operations of some magnitude in connection with the construction of factories were submitted to experts before being commenced so that the experts could see if there were likely to be any snags which would lead to accidents. Experts would often be able to point out such snags.

Hope Bagenal *(UK), architect:* Where trading estates find themselves near housing estates, they must try to foresee what their noise sources will be

Hope Bagenal (UK), consulting architect, Hertford, gave a paper on general purpose halls.

and deal with them because our new legal aid scheme will enable humble sufferers from noise nuisance to bring injunctions against offenders much more easily than they used to be able to do.

Clive Pascoe: Briefing in industrial architecture is a point to which sufficient attention has not been paid. The architect's brief and the original thought and research that goes into the planning of a factory is probably more important in this field than in any other because there are so few good examples to follow.

Edward Mills, *replying to the discussion:* The disposal of trade effluent requires very considerable research. The old-fashioned and very undesirable practice of tipping trade effluent into the nearest river is now coming to an end through legislation. Unfortunately, many industrialists do not know what to do with their waste. I know of chemical factories producing a highly toxic effluent and they have not the foggiest idea what to do with it, and they are trying to devise a means of purifying it. I have seen disposal plants bigger than the unit producing the effluent.

If only it can be got over to the industrialist that the architect can concern himself not only with new building but also the rehabilitation of old buildings, we can serve a very great purpose and do a very real service in increasing the efficiency of existing factory buildings.

DESIGN SYMPOSIUM: Schools

From the three papers presented in this symposium, we have selected one, by S. A. W. Johnson-Marshall, for summary. The discussion which follows relates to the entire symposium, which included papers by Laurence B. Perkins (USA) and Alister MacDonald (UK).

S. A. W. JOHNSON-MARSHALL *(UK), Assistant Senior Planning Officer, Reconstruction Areas Group, Architects' Department, London County Council*

At the present time there are about 1,400 new schools under construction in England and Wales and about 550 have been brought into use since the war. Nearly 80 per cent. of all these have been Primary Schools, but the ratios are changing and will soon be reversed. The difference between the needs of young Primary children and those of senior Secondary pupils is probably greater than that between senior Secondary pupils and University Arts students. Under-estimation of these differences has been common and has often reduced the value of otherwise excellent design and research work.

The war upset the building industry and dispersed much of its manpower to other occupations. Full employment in other industries where pay and conditions are good has attracted men who might otherwise have resumed their previous work. In consequence it is common to see less than 20 contractor's men on a job which requires 100.

As a result, traditional methods of construction have, in most areas, proved to be far too slow, and in consequence many of us have been encouraged to adopt a new approach to building technique. If new techniques are to be effective on a large scale during a period of shortages they require new administrative processes.

Fortunately, the Local Education Authorities, who are responsible for providing schools, now know their precise building commitments up to a year and a half ahead of the commencement of projects, and they know their approximate commitments three to four years ahead.

Several promising new techniques have been evolved since 1946, and an increasing proportion of each annual programme is

being constructed in one or other of them. In addition, four or five new systems are in the course of development.

THE HERTFORDSHIRE SYSTEM

In 1946 the County was faced with a large and urgent building programme in which schools appeared to have first priority. The supply of steel was meagre, timber was almost unobtainable, and while bricks could be obtained there were no bricklayers to lay them. Owing to the closing of war industries, factory space was available. There seemed to be a case for using a light form of construction—perhaps a light steel frame with concrete roof and wall cladding—capable of dry assembly and factory production.

Structure must be the servant of planning, so a careful study of planning requirements was undertaken. It showed that even classrooms were not a standard shape or size, that they only comprised about one-third of the accommodation, and that, if possible, the building should be considered as a whole. This appeared to rule out techniques which had been based on the conception that classrooms were a preconceived element common to all schools, and should, therefore, form a unit of standardization. In the circumstances it appeared to be preferable to standardize small components which could be assembled in a variety of ways and which could be used for an infinite number of plan forms.

A further examination of planning requirements showed that the " comb " or " ladder type " of plan which had become popular in the 1930's was open to serious objections on educational grounds. It had been evolved in a justifiable attempt to improve lighting and ventilation and to control noise, but in doing so it produced buildings without a focal centre and with a consequent loss of unity; buildings in which distances from one part to another were excessive, and whose long corridors endowed them with an institutional character. More of the compactness and homeliness of the 1880 schools were needed, but all the physical advantages of the " ladder plan " were wanted as well. In Primary schools this indicated a need to concentrate the large elements of the plan, such as the entrance hall, the assembly hall and the dining room, as a nucleus off which short wings of teaching accommodation could radiate.

An 8-ft. 3-in. grid or module was adopted, not because experiment had shown it to be particularly suitable to standardized components, but because it had been recommended in the Wood Report of 1944, and because some manufacturers had plant jigged up for it.

From this stage onwards components for structure and services were designed jointly by architects of the development group and the manufacturers concerned. Bulk ordering enabled the cost of jigs and moulds to be spread over ten or more schools and avoided the heavy expenditure usually associated with a " first off." No detailed specification was drawn up at the outset because it was felt that it would inhibit development and there was insufficient time to produce a prototype.

The single-storey structure that emerged permits rooms of three heights (approximately 8 ft. 6 in., 12 ft. and 17 ft.) with clear spans of 8 ft. 3 in., 16 ft. 6 in., 24 ft. 9 in., 33 ft., and 41 ft. 3 in. Steel stanchions, of which there are three, are 5½ in. square on plan and are multi-punched. They always occur at the intersection of grid lines, and as all faces of the three types are similar, standard length beams and cladding rails can be connected to any surface. There are five beams. Top and bottom chords are of flat or channel section and are connected by a welded lattice of short rods. End plates are holed for bolting to stanchions. Horizontal cladding rails are bolted between external stanchions and carry cladding blocks and window surrounds.

Wall cladding is in the form of vibrated precast coffered concrete blocks. Ferrules for fixing bolts are embedded in the back. Blocks are 2½ in. thick and 10 in. wide, with a maximum length of 8 ft. 4 in., and are fixed vertically. The best surface finish has been obtained by embedding stone chippings in white cement.

Roof slabs are in the form of reinforced concrete coffers 4 in. deep with intermediate stiffeners notched to allow electrical services to run above the ceiling. Slabs are 8 ft. 3 in. long by 14 in. wide, and they span direct between beams. Insulation board ceilings are fixed immediately below the underside of these slabs. The roof is thinly screeded to falls in vermiculite and is weather-proofed with sparfaced roofing felt.

Windows and external doors are made of galvanized steel " factory glazing " sections. There are 40 types and they vary in height from 2 ft. 3 in. to 17 ft., and may be one-third, two-thirds or a whole bay in width. In classrooms, side-hung opening lights are used from cill height (2 ft.) to door head height. Above that, fixed lights or ventilators are used as required. Glare is controlled by adjustable venetian blinds.

Wherever extra daylight is required inside the building a standard top light component is dropped in position in place of a roof slab. The simplicity and cheapness of this component has proved a considerable help in planning. Heating is by thermostatically controlled warm air and wiring is in a non-conduit system.

More than 150 schools have been or are being built in this system of construction. In spite of delays in the delivery of components, many of them have been constructed in about twelve months, when the national average for similar schools in orthodox construction was over twenty months.

DISCUSSION

Richard Llewelyn Davies, *Nuffield Organisation* : We have succeeded in getting an enormous building programme for schools up and into use. Also, we have developed as part of our programme non-traditional building of very considerable significance both economically, as a method of getting buildings into use, and architecturally in bringing a new form into use within the ranges that architecture has had at its disposal.

The stage we have reached is a broadening in our approach to these questions, due in very large part to the initiative of the Ministry of Education who is educating at least one group in this country, the architectural profession. The Ministry of Education is educating the architects to understand the role that prefabricated buildings can play in the school building programme and will later play in other building forms alongside traditional methods which will remain in use simultaneously. It is very wisely encouraging development in various selections. It would be wrong to take too dogmatic a view of the best way to make the next stage of progress, and some lines of development may prove abortive while others are fruitful. A significant policy decision is that to encourage the production by industry of standard parts or sets of parts rather than the production of buildings.

In contrast with traditional methods of building which are derived from gradual development, decisions in relation to non-traditional systems of building have to be taken by those responsible at a very early stage. Such simple intellectual conceptions as the choice of a number or a dimension carry with them profound aesthetic consequences and may in the long run change the face of Britain. The responsibility on architects is very great. To some extent their actions control the degree and flexibility and the aesthetic potentialities of these new methods of building. What has been done in the past to develop fine architecture is a monument to everyone connected with the work.

W. Tatton Brown, *Deputy County Architect, Hertfordshire*, said : The problem of heating schools can almost be said to be the problem of heating schools up to 9 a.m. Once the children are in it can very largely be left to them by means of their body heat in the classrooms.

Andrew Cox, *Architects Co-operative Partnership* : School construction is not merely a problem of economic construction, planning, providing satisfactory answers to certain measureable functional requirements or creating a satisfactory environment in which to bring up children ; it is the problem of doing all these things at a price which we can pay and doing them against time, not only time on the site but time in the design, the drawing office, and administrative time as well.

The primary function of the architect is not to express himself through buildings but to find answers to the material problems that society sets him. If he fails in that, someone else will do that for him.

Dr. Lea, *Director of the Building Research Station* : We need to interlink research and development with design and manufacturing procedure. The extension of our role raises serious problems of machinery for integrating the development team and research with the client. It is to that type of machinery that we are at present turning our minds in order to find a practical solution. That is the line on which building research must proceed.

D. M. Nenk, *Joint Head of the Architecture and Buildings Branch, Ministry of Education* : The Ministry has always tried to view the question of reducing costs as an economy—getting better value for money—and not as sacrificing educational standards on the altar of Mammon. It is significant that we are building schools more economically than we were before the war. The buildings are being planned more economically and more compactly, and non-educational space has been sacrificed to educational space. To get a

sound approach to economy there must be joint consultation and joint work by all kinds of specialists.

Alister MacDonald (*UK*), *Founder Chairman of the RIBA Architectural Science Board*, replying to the discussion : We have heard a lot about the speed with which building is done. We have all had experience of designing our buildings and arranging the construction and everything else so that everything will go quickly, only to discover half way through the job that it will be another four or five months before the lavatory pans can be delivered, which holds up the completion of the job. Mr. Taylor may be smiling to himself that we take so long to build the wonderful schools we have been describing. It is partly due to the fact that we have not quite got the technique of progressing the job sufficiently well. The Americans do it much more than we do. In America not only is everything preplanned from the architect's point of view but it is also pre-planned from the point of view of the lavatory pans. If it is known that they are wanted on November 17, it is somebody's job to see that they get there by November 17. I believe that in America gentlemen go around on the railway trucks accompanying the lavatory pans to see that they arrive on the job at the right date. The architect must tackle progressing as well as the 101 other things he already has on his plate.

Walter E. Taylor (*USA*), *Director of Education and Research, American Institute of Architects*, also replying to the discussion, said : I support what was said by Mr. Davies about this being an era of achievement in non-traditional design. I saw a school at Welwyn Garden City, and I was really thrilled by it. It is a great relief from the crudity, brutality and barrenness of so much contemporary design to see the fineness and delicacy that I saw in that building, and I congratulate everybody concerned with it.

Sir John Maud, *the chairman*: Shortage of labour on the site and other shortages make more development work by more development groups to discover techniques which will work an absolute essential. The stakes are very high, and we may fail. At the moment I think that we are not failing. Two thousand schools have been built or are building since the war, 550 have been finished, and 1,400 are going forward at this moment. That is a great achievement. There has been a great deal of praise for the Hertfordshire County Council, but let nobody doubt that there are many other local authorities who are doing excellent work. The Hertfordshire people would be the first to say that they are only blazing a trail and that they expect to learn as much from other people as I believe other people may learn from them.

This is not a case of one way only. I believe that Mr. Aneurin Bevan would agree with me. What we want are more local authorities and more development groups bringing together the architects, the industrialists, the scientists and the educators at a high level to bridge the gap between research and building in quantity. I was greatly encouraged by Dr. Lea's remarks that the Building Research Station believes in this work. As we get down to new techniques we have a greater need of building research. It is most encouraging to find general agreement among local authorities, central departments, private architects and public architects, private industry and public corporations in regard to the challenge which is presented by the times and the hope that through development work we can make sufficient progress.

Do not let us forget that all this is for persons, for the children and the people who have to teach them. It is the child who ought to be the centre of our comprehensive high level development work.

This country is committed to do away with the disgrace of a two-nation system of schools. The poor boys' school has not yet quite passed away. The children for whom we are watching and administering are *the* children, all of them very poor from some points of view—when you look at their parents—but all of them equally rich in their individual possibilities. The only standard to which any of us can attach ourselves is the one-nation standard of giving through our schools the best chance that each child can have of finding fullness of life through education.

The absence of knowledge regarding recent developments in the application of paint makes the paper on this subject, presented to Division 2 of the Congress by L. A. Jordan (UK), Director of the Paint Research Station at Teddington, unusually important. We have, therefore, printed it in full, together with a short report of the ensuing discussion.

MATERIALS : Paint

The full text of L. A. Jordan's paper on The Application of Paint, followed by a report of the discussion which ensued.

L. A. JORDAN (*UK*), *Director of Paint Research Station, Teddington.*

Starting with an ordinary can of paint and a brush there is much scope for disappointment, unless one knows something about how to put it on, especially if one aspires to achieve a decorative effect which satisfies the eye or gives a reasonable prospect of good durability.

Of course there are degrees of performance possible by the same individual according to the nature of the material. Thus, one kind of camouflage paint (based on wool-grease emulsion) made during the war in considerable quantity was familiarly known as " soldiers' joy " because anyone could put it on anyhow at any time (more or less) and the result would withstand scrutiny. At the other end of the scale, the good painter-craftsman knows how to impart a sense of quality to his work whether it be simple and utilitarian or highly decorative, depending for its appeal on colour, or on the perfection of finish associated with say coach-painting. He knows how far the neophyte is from such achievement.

The significance of application is, however, most marked in the specialized methods adopted in industrial operations. Very few of the ordinary manufactured things of life except textiles, and those only in part, escape the attention of paint or varnish or lacquer in some form or other and application is a highly specialized process utilizing equally specialized equipment. Also very definitely the material has to suit the job and the different methods of finishing have their own technologies—one thinks of two-colour spray guns as an example of specialized equipment and a wrinkle finish as an example of the use of specific material. Without the one or the other, as the case may be, the desired result could not be obtained.

THE IMPORTANCE OF FINISH

The importance of finish has caught the public eye—not only in the obvious things like automobile and house decoration, but in the multitudinous items among household appliances, toys and many other things. The consumers buy after appraisal of quality of design, quality of material, quality of craftsmanship. Whilst these three qualities are interdependent, the finish is the aspect of craftsmanship that counts most. The customers see the paint first and if they do not like the appearance of the article, *i.e.*, the colour and the general effect of the paint, they may not stop to consider the merits of the design. Indeed, it would not be surprising to learn that good finish can sell bad design (as least I personally have been deceived that way), but be that as it may the individual's reaction always is—the better the appearance the higher the value.

The ability to make first class paint has always been a British tradition and a great volume is prepared for use on manufactured articles in great variety from the tag on a shoe lace to a locomotive and, quite rightly, a great deal is expected from paint. Too many users, although always prepared to stress the quality of paint, fail to remember and provide for the corresponding quality of application which starts, not with the finishing coat, but with the pre-painting preparation. It is often so easy to solve a problem of cost or space or delivery by cutting somewhere on the paint and the painting schedule.

As to quantity of paint used, there is usually a threshold value of paint thickness below which performance dwindles away. Then it is not often realised that the appearance and behaviour of a finish are really determined by what it put underneath; the priming paint,

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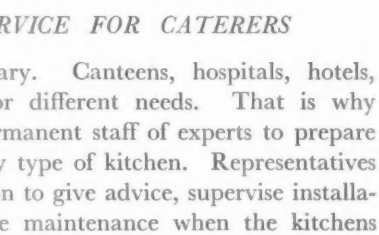

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TRADE MARK

undercoats and finishing coat all need to be well matched and to be capable of producing a composite whole. Even before the priming coat is applied there is the preparation of the surface—and whatever expense is incurred in the preparation of a surface before painting is usually justified many times over by result. Every different type of surface—metal, plaster, concrete, wood and fabric—all bring their own painting problems which call for special study. In the case of iron and steel there are the ever present problems of rust removal, degreasing, phosphatizing and like processes, priming with rust inhibitors and the like.

Cost analysis, standarization and the use of the right materials are essentials of good product design. It may well be that finishing coats of paint or the nature of service required from the article, may be a determining factor in selecting a production method. Such matters should be studied and decided before the plan is put into execution and not as an afterthought.

I mentioned above that users are usually prepared to stress quality of paint, by which I really meant to imply that great care is necessary in selecting a finish, more so than is apparent at first sight, to secure the desired film properties as well as the immediate appeal to the eye of the article painted.

Properties of a general character which come to mind are—hardness, degree of matteness or gloss and retention of gloss, durability, colour quality, resistance to fading (or resistance to yellowing if white), and time of drying. Particular properties may be associated with food contacts (resistance to grease, etc.), non-toxity, as in the case of children's toys, or the capacity to take a polish or to give a special type of finish, say wrinkle or crackle or polychromatic.

For all these properties there are specific tests by which paint may be appraised, at least up to a point. The tests range from simple action like brushing out to the use of elaborate, often over-elaborate, more or less precision instruments, the results of which require interpretation with a good deal of judgment. Frequently there is a variety of methods all purporting to do the same thing, a sure sign that none of them do the job with complete satisfaction.

However, my purpose is not to discuss testing of paint and paint films, and so we will pass on.

At this stage it would be logical in the sequence of thought to speak briefly about the Nature of Paint so far as is necessary to uphold the thesis about the importance of application.

What is paint? Shortly expressed, it is a composition consisting of a solid material (the pigment) in a fluid material (the medium), so prepared as to be suitable for application to a surface and capable of forming a continuous film having the nature of a gel binding the components together.

The science involved in the study of paint is profound. What happens when the component materials are brought together? What is the mechanism of film-formation? Why the breakdown and decay of paint films on exposure, and what is the nature of the forces responsible? All these are more or less open questions of great interest and importance.

As to materials, the traditional pigments, oils and resins are still used along with the new chemically-prepared substances — "synthetic materials" so-called—which in great and ever-growing variety find use in paints, lacquers and finishes of all kinds.

One of the most important classes of the so-called synthetic resins is that of phenolic resins, broadly produced by the chemical condensation of phenol (or its homologues, *e.g.*, cresols and xylenols) with formaldehyde —a process which takes place in stages, is capable of control, and in the limit produces an infusible insoluble compound well known as the basis of moulded products. The preparation of such resins so as to retain solubility and to permit of incorporation into drying oil presented some difficulty at first, but is now well understood and very successful.

Then there are the alkyd resins which, although younger than the phenolics, have outstripped them in importance, if that property can be measured by world output. Alkyd resins started from the condensation product of glycerol and phthalic anhydride and at first presented difficult problems of plasticization to give adequate flexibility. Today the variety of such products made and used is considerable, for phthalic anhydride can be replaced by related (dicarboxylic) acids, such as maleic and succinic, and glycerol by glycol and other polyhydric alcohols. In mixed condensations using vegetable oils or their fatty acids, the glycerol acts as the connecting link between them and the phthalic molecule. Some alkydes make complete paint media; others are used as plasticizers for nitro-cellulose lacquers and for urea-formaldehyde resins.

The urea resins and, to a less extent, the related melamines, have been established for some time as stoving finishes, of which the standard white refrigerator finish is the commercial example. It is well known that the production, mainly in America, of styrene for war purposes has been enormous. Its utilization for paint purposes is parallel to the development of nitro-cellulose lacquers after the first world war. Styrene may be treated with certain drying oils (such as those containing conjugated double bonds, like tung oil and dehydrated castor oil) to give clear varnish-like products which have good pigment-wetting properties, and as paints have good gloss and weathering properties.

Vinyl ester polymers and copolymers are also used as the basis of lacquers and, in the form of aqueous dispersions, as a basis for water paints. Such paints dry rapidly and soon become highly water resistant, considerably in advance of the traditional water-paint, except perhaps in ease of application, which needs care.

Of the older paint-making materials linseed oil is still the best known, and likely to remain the most used medium for paints either directly or as a varnish component, or in one of the more developed forms mentioned. There are, of course, other drying oils, actual and potential, and all of them have one property in common, which is carried into the various compositions of which they may form part, namely, the capacity to absorb oxygen from the air and sooner or later to produce a film by gelation. It may be accepted that quite a lot of good paint can be and will still be made from the traditional oils and resins.

The story of the development of modern paint materials can be summarized as follows:—

A generation or so ago there were fairly good permanent finishes of a kind, but restricted by the limitations of materials. Reliance had to be placed mainly on comparatively simple pigmented linseed oil compositions, giving films which, although of good weather-resistance, were relatively soft; by modern standards the gloss was not high or well retained, and surfaces so painted sooner or later became shabby and dull. It is true that excellent "deep" glossy coatings such as those associated with coach-finishing were prepared, but they involved many coats and the laborious processes of flatting and varnishing. With a growing knowledge of oil treatment, the modification of natural resins, the introduction of synthetic resins and cellulose derivatives, new pigments and pigment dyestuffs, and greater control in manufacture, there has gradually developed the factory production of ready-mixed lacquers, varnishes and paints in a wide range of types of reproducile quality.

Much of this evolution is the direct outcome of the demands made, not only by the constructional materials and the facilities provided for specialized application, but by speed in industrial processes, particularly in mass-production where delay at any one stage may destroy the synchronization of a series of operations. This matter affects the building trade in the delivery of prefabricated metal units, such as window frames, primed in the factory for protection during transit and erection, and it is even more apparent in the motor-car, aircraft and small-goods industries for which quick-drying finishes, applied by dipping or spraying, have become essential.

The materials generally known as industrial finishes cover all the different types of material, whether paint, lacquer or varnish. The band of composition and the special methods of application necessitated by painting schedules, are so wide that it is scarcely practicable to attempt a survey.

STOVING

The term "stoving finish," however, requires some explanation, and it refers to the method of drying. In the ordinary way paint dries in air, but it can be made to dry much more rapidly under artificial heat to give finishes with a hardness and quality of adhesion seldom achieved with air drying alone. The heat may be applied by convection or by radiation as in the infra-red or radiant-heat method of drying of paints—an important process which has come into prominence by the need for rapid processing in war production.

Compared with drying by ordinary (*i.e.*, convection) oven stoving, radiant heat drying may be up to about twenty times as rapid, depending on the type of material and processing involved. The method consists in directing an intense beam of radiation, largely in the near infra-red (0·7 - 5μ) region of the spectrum, on the painted article, causing rapid heating of the surface. Any intense source of radiation may be used, *e.g.* electric heating elements, carbon filament or tungsten filament lamps, gas fires, or gas-muffle type elements, the temperature of the source being in the region of 1,500-2,500°C.

Although an intense source of heat is required for infra-red drying, the process is said to be more economical in fuel consumption than convection oven drying so long as the maximum through-put is maintained, because a much larger proportion of the total heat is directed to where it does most useful work, *i.e.*, at the painted surface, and if necessary can be localized. In a convection oven much heat passes up the flues and more is used to heat masses of metal, either of the oven or the article painted. By the infra-red process the painted surface rapidly reaches a high temperature, but the bulk of the metal usually remains at a much lower temperature. It is not uncommon to find that the average temperature of the body of a stoved article of massive metal removed from an infra-red or radiant-heat oven is little more than warm, whereas the painted surface may reach, say, 200°C. for a short period.

By choice of a radiation source covering a suitable band of wavelengths, it is possible to ensure that the film absorbs energy in a reasonably uniform manner throughout its thickness, and thus hardens regularly without wrinkling or other defects which may more readily arise in a convection oven. The extent to which this uniform energy distribution is achieved in practice will depend in part upon the shape of the article being treated; much may be done by the design of the apparatus and the disposition of the heating elements, but articles of "awkward" shape present difficulties owing to "shadow" effects.

Developments in stoving are towards shortening the stoving time and reducing the temperature which generally improves the appearance and durability of the finish. Finishes are also now made utilizing suc-

cessive coats applied "wet-on-wet," *i.e.*, the wet coat is applied before the earlier one is dry, although it will have set, and finally the whole assembly of coats is fully dried by stoving as one.

STOVING FINISHES

Stoving enamels can be made to give a wrinkled finish, which, apart from having a special decorative effect, is economical in that steps need not be taken to hide imperfections which would show up in an intolerable manner on an ordinary lacquered or enamelled surface.

Most stoving finishes today are of the synthetic enamel type, by which is meant compositions based on resins built up by chemical processing, although certain natural products may be incorporated in the mix.

Perhaps now it would be wise to say a little about brushing—the classical method of painting and still the method used by the craftsman to produce the highest class of work. Paint can be applied by brush with the maximum degree of physical control over the operation; not only is the positioning of the applied paint controllable, but the thickness and uniformity of the film can be controlled by judicious manipulation. With the brush, paint can be worked into every detail of the surface, giving a complete covering, drying to a "solid" appearance.

The flow properties of oil paints have been developed to suit the brush application technique, by variation of pigmentation, thinner content and viscosity of the oil or varnish medium. The essential requirements are that the paint shall

(*a*) move easily under the brush;

(*b*) flow sufficiently for all brushmarks to disappear;

(*c*) cease flowing before tears or curtains are formed;

(*d*) keep "open"—that is, capable of being reconverted by shearing to a free flowing liquid—for a time long enough for the painter to join up with all wet edges, an important matter when painting large areas.

These conditions can be satisfied in an oil or oil-varnish paint. Conditions (*c*) and (*d*) require a degree of thixotropy in the paint; that is, after the shearing force of the brush has been removed, the apparent viscosity of the paint must increase. Condition (*d*) requires that the drying time shall not be too short—five to eight hours is usual for a decorative paint.

Whilst the general pattern of properties can easily be obtained by any competent paint technologist, the development of the perfect brushing qualities without detriment to gloss and durability requires considerable skill and experience.

When large-scale production of motor vehicles began in the decade after the first world war the old-fashioned coach-finishing techniques involving brush application of many coats of paint and varnish became impracticable. Processes involving less labour and, more important, a much shorter time schedule were essential. The situation was met by the introduction of cellulose lacquers—solutions of nitrocellulose, resins and plasticizers—which formed a film by solvent evaporation. These lacquers possess very different flow properties from those of oil paints. Initially the resistance to brushing is less than that of an oil paint but as solvent evaporates the lacquer sets up rapidly and can only be brushed, without leaving marks, for a very short time; if solvents with low evaporation rates are used, tears and runs occur.

SPRAYING

Spray application was a necessary counterpart of NC lacquers and was introduced into motor-car factories and many others to avoid the difficulties experienced with brushing cellulose lacquers, which never have been much used except for small work. By the spray technique a uniform film can be applied to a large surface and can penetrate to areas beyond the reach of a brush.

Under factory conditions spray painting is much more rapid than brush painting. A lower degree of skill, and hence a shorter training period, is required for spraying than for brushing; many faults are possible in spraying, but they are mainly due to errors which can be corrected by the shop foreman rather than to poor craftsmanship.

During the war, spray technique in the application of paints, bituminous compositions, metals, etc., developed considerably. There is now a greater facility in the design of spraying equipment but, although certain earlier prejudices have been largely overcome, spray application cannot be expected universally to replace brush application; indeed, there is a considerable body of opinion which holds that the mere act of brushing paint on to a surface is of value in securing the intimate contact necessary for good adhesion and protection. This applies particularly to outdoor protective painting work. Apart from those circumstances which make spray technique essential, there is little doubt that spray application is more generally acceptable than it was for many classes of work, and that the manufacturers of equipment will be able to meet all reasonable demands for specially designed guns, etc., to suit circumstances and materials.

Spray painting as normally practised, that is by atomizing a paint or lacquer, thinned to a low viscosity, by means of a relatively large volume of air, has two big disadvantages; it is wasteful both in thinners and in paint lost in overspray and, unless carried out in a specially designed, ventilated booth, is messy and hazardous to the health of the workers. In the last ten years there have been a number of modified processes developed to overcome these difficulties, but before passing on to these I want to say a word about some cases of severe flaking failures reported when paint has been applied by spray to buildings under conditions of high humidity. Such failures may occur on both interior and exterior surfaces. In some of the more dramatic cases, the paint is alleged to have fallen off in large sheets within a few days of application, indicating a complete lack of adhesion which could be associated with condensation of water, either in the paint spray or on the surfaces to be painted.

There are at least two ways in which water might appear in the paint spray:—

(i) the air supply itself might be grossly wet, containing water droplets in suspension;

(ii) the spray might be cooled below the dew point either by cooling of the air on expansion or by absorption of latent heat on evaporation of solvent.

USE OF WET AIR

The possibility of wet air can and should be eliminated by proper design of equipment, but lacquer sprays can be cooled very severely if low boiling solvents are present; a temperature drop of 20°C. or more being possible when spraying straight solvent mixture. As a 10°C. fall in temperature in the range 0-20°C. will cause condensation for relative humidities above 50 per cent., it would seem reasonable to suppose that lacquer spraying can involve water condensation unless conditions in the workshop are well controlled. In outside work this trouble is a real one. Another possible cause of adhesion failure of paint films applied by spray is the presence of a film of water on the surface before spraying. This may occur both inside and ouside buildings under suitable conditions and may not be apparent as a visible film.

When a stream of warm air with a relatively high water content impinges on smooth surfaces with poor thermal insulation, such as damp well-trowelled plaster walls, a film of condensed water often forms on the surfaces. This effect is very noticeable when a period of cold anticyclonic weather is terminated by a warm, damp, south-west wind, and is probably the cause of some of the more dramatic reports of spray painting failures. Under suitable circumstances, water from the spray itself might be condensed on the painted surface if the surface is significantly colder than the spray.

Exterior surfaces often cool rapidly during clear, cloudless nights and become covered with a fine dew which may persist for some hours after sunrise. Spraying on top of this condensed film gives rise to a porous film lacking in adhesion. Laboratory tests on steel panels artificially covered with dew by cooling with solid carbon dioxide support this statement.

When atmospheric conditions are such as to favour the condensation of moisture on cold surfaces, a careful examination should be made before deciding to paint by spray. Particular attention should be devoted to those areas most likely to be affected, *e.g.*, heavy interior steelwork and exterior north-facing doors or window frames. Spraying should not be carried out under misty conditions or at any time of day when dew can be expected, even if it cannot be seen on the surfaces to be painted.

Among recent developments in spraying techniques is *Electrostatic Spraying*, which is a most ingenious device.

The article to be painted is earthed and placed at a distance from an electrically charged wire grid (usually 80 to 130 kV.) from which there is a silent discharge of electrons. Paint droplets caught in the field acquire a charge of the same sign as the grid and are thus attracted to the work-piece and, in consequence, losses of paint through overspray are negligible. By suitable disposition of the grids and rotation of work-pieces it is possible to obtain a uniform coating on most surfaces other than re-entrants or interior surfaces where the field strength drops to zero; these latter surfaces may be sprayed by normal techniques before the article is passed into the electrostatic spray booth.

Electrostatic spraying is essentially an industrial process and is best operated with automatic spray guns and a conveyor belt system. The paints used are modified by the addition of less volatile solvent than that used for normal spraying to counteract the much longer time that elapses between atomization and deposition of the droplets on the surface to be coated. Low air and fluid pressures are used to produce the necessary low velocity spray and the length of path from gun to paint film may be as much as five feet. In some recent developments of the process air atomization is dispensed with, the paint being simply dripped into the electric field.

HOT SPRAYING

Hot Spraying is another new technique developed to enable a thicker coat of cellulose lacquer to be deposited with incidental economy in solvent. The lacquer is heated, usually to about 70°C., in a special container and is sprayed by a gun with a heated nozzle. Considerable progress was made in the development of hot-spray lacquering of furniture in Holland and Sweden during the war, largely to reduce solvent consumption, and the technique is now widely practised.

It is claimed that in America over 100,000 gallons of lacquer are hot-sprayed each month; one manufacturer claims that by using the process he saves 50 per cent. of the thinners previously used and has doubled production on the spray-line.

In addition to obvious factors, such as saving of solvent and the elimination of solvent retained by the applied film, particular importance attaches to the possibilities of applying (*a*) thick coatings (*e.g.*, from compositions of high solids content), (*b*) materials which are difficult in respect of solvent requirements and cannot normally be applied readily as lacquers, and (*c*) materials polymerisable by heat in situ.

Steam spraying, that is the use of superheated steam to atomize paint, is another very recent development. The method was worked out to enable a film 0·002 in (50μ) thick to be applied in one coat under normal working conditions. Steam from a high-pressure boiler is passed through a pressure reducing valve, superheated to maintain a temperature above 250°F. at the gun and

used much as compressed air in an orthodox spray gun to produce a spray mist.

The chief advantage claimed is that materials of higher viscosity can be sprayed, enabling thicker coats to be applied with less solvent; condensation of the steam in the atmosphere is said to reduce the spread of the spray mist as compared with air atomized paint and thus to reduce over-spray. The cost of steam is usually less than that of a comparable volume of compressed air so that, except possibly in initial plant outlay, the process is not uneconomical. Against these advantages must be set the fact that the introduction of large quantities of water-vapour into a room where spraying is being carried out is a dangerous procedure and is liable to cause corrosion troubles if heavy metallic articles (of high thermal capacity) are brought in to be painted.

Flame Spraying. The logical development of hot-spraying is to raise the temperature to such a degree that the use of solvents can be eliminated entirely. This has been done in the so-called flame-spraying process. In this process the film-forming material is fed to the gun as a powder, a wire or a hot liquid which is sucked into the core of a gasflame and blown on to the work in a molten condition. The advantages of this system over normal air-temperature spraying are obvious; a film of any thickness can be built up without any danger of entrapping solvent; sparingly soluble resins which cannot readily be applied in solution form can be flame-sprayed if they melt, water present on the surface before painting is volatilized and does not impair the applied paint film.

It is stated that any material which melts below 1,600°C. can be applied by flame-spraying, using an oxy-propane flame. Many thermoplastic materials are commonly flame-sprayed, especially bitumen, polythene and polysulphide rubber (Thiokol). Metal coatings, aluminium and zinc, in particular, may also be applied by this technique.

The process is particularly useful for the application of thick chemically resistant coatings to industrial plant, *e.g.*, plating baths and jigs. It is almost the only satisfactory way of applying coatings of polythene—or so it is said.

An interesting approach to the spraying problem is the *Air-less Spray gun*, which depends on the ejaculation of a spray of paint from a spinning cone by centrifugal force. The spray is controlled by baffles so that it can be directed on to limited areas of a surface. It is too early yet to assess the potentialities of the method, but the elimination of an air supply with the attendant risks of contamination by water, oil or dust is an attractive feature.

NEW SPRAYING TECHNIQUES

The progression of development in spraying techniques as we have so far traced them from the normal methods, from using high pressure air to the air-less gun, completes the full cycle with the *pressure-fed paint brush*, which is an attempt to get the best of both brushing and spraying techniques; the method is fast, since a continuous supply of paint is fed to the brush as to a spray gun nozzle, and at the same time it is possible to rub out the paint into the surface and brush it out evenly. Such apparatus of this type as is at present available appears to be valuable for rough maintenance painting, but not so satisfactory for high-class decorative work.

All these methods of spray application have their uses and lead to particular results which are reflected in the nature and quality of the film produced.

Manifestly there is much scope for selection of the material, only certain types being suited to particular methods, as well as adjustment to operating circumstances. The literature abounds in precisely detailed descriptions of the apparatus required and the manner of its use, the layout of workshops for carrying out the operations, the use of pressurized spray rooms, safety and ventilation requirements, and a multitude of other related aspects which are beyond the scope of this address.

As to film quality, there is little doubt in my mind that the ideal product is one which can be applied in fluid form and be capable of setting without change of volume or loss of solvent, changes which entail disturbance of the film structure at its most sensitive and formative stage. One approach to this ideal is flame spray application, but the list of coating materials capable of being so applied is very limited. The art of stoving is perhaps the nearest practical interpretation of the idea. The paint material is applied and the film first formed loses solvent or thinner as the case may be by evaporation. Then, under the heat of the stoving oven, the film material liquifies again, if only for a very short period, and polymerises in place to the great benefit of the final film. If to speak of liquefaction of the film is a slight exaggeration, at least the material softens and flows enough to ease any structural strain.

Reviewing the general methods of paint application, there is the *traditional* based on the brush, which still accounts for a large production, the *modern*, which is centred mainly on the spray, and the *specialized*, which includes dipping, flowing, tumbling, roller coating, and the doctor blade or knifing method as commonly used for the production of painted textiles and artificial leather.

Probably the oldest method of application is the one still used in French polishing and the like, which consists of applying the coating to the work by a pad of soft fabric soaked in the paint or varnish.

The paint brush has long been, and still is, the prime tool of the painting craft, and the evolution of brushes is interesting. It is possible that very early man found that single reeds and single feathers facilitated the spread of the first crude colours and, so far as is known, brushes as we understand the description were first made by stuffing reeds into the hollow centres of animal horns, and they go back to early Egyptian times.

From a bunch of reeds to small feathers and animal hair, and ultimately to bristle, were but steps, and such brushes were well-known long before the heyday of Greece and Rome. Even during the last war serious proposals were made in England to manufacture paint brushes from feathers. The use of hog bristle, first Russian and later Chinese, goes back to the beginning of the Renaissance of the Middle Ages, and from that we jump to the modern nylon.

It is amazing how little the general appearance and form of a paint brush has altered in 2,000 years or more, but it has been a tool of enormous significance. Until comparatively recently all paint materials were expected to be applied by brush and, indeed, were best suited to that method.

As the synthetic materials including nitrocellulose came forward, great attention was paid to the preparation of the material in such form that it could be applied by brush. This urge is passing to some extent, partly because of the diminution in the numbers of expert painter craftsmen, but mainly to the increase in mass production operations and the development of specialized equipment for applying paint by the new techniques which have proved amenable to factory operations.

THE PREPARATION OF SURFACES

There is one other broad subject of great importance in the application of paint, namely the preparation and pre-treatment and priming of the surfaces to be painted, whatever their nature. It is comparatively easy to list the attributes of good paint finishes, but, by and large, it is no use dodging the column on this issue of preparation, for without good work right from the foundation on which the paint system rests, the application quality will be faulted.

These arguments apply to iron, light metal alloys, wood, plaster, concrete and everything paintable, but what is required varies in each case, for obvious reasons.

The technical journals discuss week by week various aspects of these subjects, and there is no need for me to say anything more here. It is all in the literature in the fullest detail.

When careful attention has been given to the selection of the paint, its nature and quality (and the paint manufacturer will do his part by ensuring that no paint is approved for sale unless it carries a full certificate from his own testing organization) and proper provision has been made for application (including the pre-finishing processes), it may be assumed that the quality of finish is well-nigh assured, especially if the operations are carried out under controlled conditions in a factory or workshop. That is the time when someone will begin to think about achieving the same finish at lower cost—quite a commendable thought in itself—but that leads to another story.

DISCUSSION

In Dr. Jordan's absence his paper was introduced by **Dr. Bell,** *of the Paint Research Laboratory*, who emphazised that despite contributions from the paint chemist the final result depended upon proper use. The discussion

Dr. Bell, of the Paint Research Laboratory, presenting Dr. Jordan's paper on paint.

which followed was anything but inspiring. It may be that Dr. Jordan had dealt so fully with all aspects involved but quite certainly nothing of particular interest was forthcoming. The paper by **Mr. Mack,** *Building Research Station*, on lime washes and cement paints was introduced by the author. The main point he made was that the modern cement paint tended to replace the simpler lime washes owing to its considerably higher durability. The main problem with cement paint was the prevention of discolouration by bacteriological and vegetative growths. He discussed the various treatments which were available to retard these growths. The discussion centred mainly on the advantages and disadvantages of substances which might be incorporated in the paint and those which were subsequently sprayed, to

G. W. Mack of the Building Research Station, Watford, introducing his paper on lime washes and cement paints.

inhibit the growth of algæ and bacteria. The discussion was on a high technical level and was rather too highly technical for the average user to take part.

Readers requiring up-to-date information on building products and services may complete and post this form to The Architects' Journal, 9, 11 and 13, Queen Anne's Gate, S.W.1.

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A.J. 27.9.51

Announcements

Following an application by the Trade Association, the Minister of Works has authorized an increase in the maximum prices of certain types of sanitary fireclay ware. As from September 12, 1951, the prices for sinks, wash tubs, tub and sink sets, standard lavatories and overlaps, 45 lb. Standard closets and drainage channels and foot baths were increased by 2½ per cent. The price of all other ware (including heavy lavatories, urinals, school closets and hospital specialities) remained unchanged. The increase was wholly accounted for by increases in manufacturing costs.

The MOLGP has announced that the Timber (Control) Order, 1951 (S.I. 1951, No. 1067), made by the BOT and now having effect under the BOT and the Ministry of Materials (Various Controls) Order, 1951 (S.I. 1951, No. 1244), as if made by the Minister of Materials. The Order came into operation on July 2, 1951, and supersedes all previous Orders made by the BOT relating to the acquisition, supply, use, and consumption of timber.

The hardwoods which are now subject to licensing control under the Order are: Canadian and American birch, hickory, rock elm, rock maple, American oak, and teak (Tectona Grandis); all specifications (except scantlings and strips 4 in. and under thick by 5 in. and under wide other than decks imported as such).

Plywood controlled under the Order consists of:—Plywood manufactured in the USSR. Battenboard, blockboard and laminboard manufactured in Finland, of any size. Any other plywood manufactured in Finland, being in boards of which neither the length nor the width exceeds 74 in. Plywood manufactured from softwood in Canada or the United States of America.

DIARY

Film Show. Houses in the town, Downlands, Fenlands and Cyprusisan Island. Organized by the Students' Planning Group of the TCPA. At 28, King Street, Covent Garden, W.C.2, at 6.15 p.m. SEPT. 27

FOB South Bank Exhibition. Daily 10.30 a.m. to 11.30 p.m. Sundays, 12.30 p.m. to 11 p.m. UNTIL SEPT. 30

London: An Adventure in Town Planning. Exhibition of work by Assist. Professor Smigielski, staff and students of the School of Architecture, Polish University College. At ICA, 17-18 Dover Street, Piccadilly, W.1. Weekdays 10 a.m. to 6 p.m. UNTIL OCT. 6

Exhibition of British Popular and Traditional Art. Sub-title: Black Eyes and Lemonade. At the Whitechapel Art Gallery. Daily except Mondays, 11 a.m. to 6 p.m. Sundays, 2 p.m. to 6 p.m. UNTIL OCT. 6

Exhibition of Architecture. Sponsored by the Institute of Registered Architects. The above exhibition will be on view at the following places:—East Finchley Library (until Oct. 6); Thomas Parsons Showrooms, 70, Grosvenor Street, W.1. (Oct. 8-19); Council Office, Surbiton (Oct. 22-27); Building exhibition, Olympia (Nov. 14-28).

Course of Three Lectures. The Cathedral of Chartres, by Jean Maunoury. (Sponsor, the University of London.) At University College (Architecture Theatre), Gower Street, W.C.1, at 5.30 p.m. DECEMBER 5, 6 & 7

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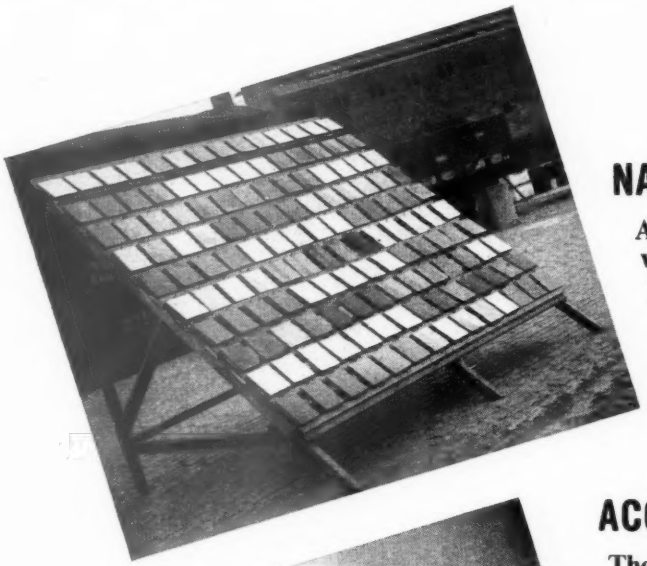

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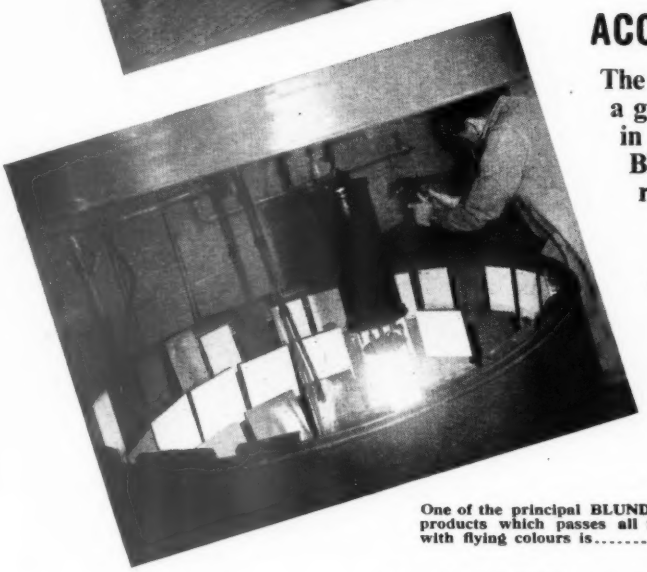

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Pimlico polygon...

a hot water accumulator that delights the eye! A 16-sided tower glazed by Aluminex Patent Glazing houses the hot water accumulator of the Pimlico District Heating Scheme of the Westminster City Council.

When a hot water accumulator tank 29 ft. in diameter and 126 ft. high is set cheek by jowl with blocks of new flats, something special, obviously has to be done about its appearance. Something, indeed, has been done, and to some purpose, to the hot water accumulator of the Pimlico District heating scheme. The remarkable photographs in these pages show how Aluminex Patent Glazing was used in accomplishing these three prime requirements of:

1 — **providing an aesthetic finish;**
2 — **protecting the accumulator and its lagging;**
3 — **providing a measure of additional heat insulation.**

In particular the architects desired that the accumulator enclosure should have a light and airy appearance and harmonise with the design of the flats in the surrounding estate.

It was with these considerations in mind that they chose Aluminex Patent Glazing—the modern, all-aluminium system—for the tower cladding. The Architects built round the accumulator a 16-sided steel tower glazed with rough cast glass panes, 6 ft. × 1 ft 9 ins., set in Aluminex patent glazing bars.

These are the normal Aluminex glazing bars as used in the Brabazon Assembly Hall, motor factories, steel works and other industrial structures large and small.

In this application of versatile Aluminex however, the tee-shaped glazing bars have been set to face inwards. This permitted the glazing to be placed from the inside, doing away with the need for scaffolding. Moreover this arrangement suited the wind conditions for the wind suction is much greater than pressure.

The manufacturers of Aluminex, Williams & Williams Ltd., carried out tests showing that the glass would not break until a suction of 65 lbs. per square foot was reached and that the Aluminex continuous spring glazing strip inside would not give way under a pulsating outside pressure varying up to a maximum of 45 lbs. per square foot. It was therefore clear that there was an ample margin of safety, since the maximum design suction is 50 lbs. per square foot and the maximum design pressure is 30 lbs. per square foot.

It is, however, from the point of view of appearance that the choice of Aluminex has been so notably justified. Aluminex is essentially a neat and precise glazing system. The bars are extruded to a design which represents the strictest adaptation of shape to function. The Aluminex engineers who designed it re-thought "dry glazing" from basic principles. The components and fixings are equally simple, efficient and functional. The result is that, in such structures as the Pimlico tower, when clean, precise lines play an important part in the aesthetic effect of the finished building, Aluminex presents invaluable advantages.

Aluminex Division *of* **Williams & Williams Ltd.,** *Reliance Works, Chester*

Architects: *Messrs. Powell and Moya, A.A.R.I.B.A.* **Chartered Civil Engineers**: *Messrs. Scott & Wilson.* **Consulting Engineers**: *Messrs. Kennedy & Donkin*

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Replies to Box Numbers should be addressed care of "The Architects' Journal," at the address given above.

Public and Official Announcements

25s. per inch; each additional line, 2s.

CARDIGANSHIRE COUNTY PLANNING COMMITTEE.
APPOINTMENT OF PLANNING ASSISTANT (GRADE VI).

Applications are invited for the post of Planning Assistant in the County Planning Department, at a salary in accordance with A.P.T., Grade VI (£645-£710).

Applicants should be Members or Associate Members of the T.P.I., preferably with complementary qualifications, and should be experienced in the preparation of Development Plans and Planning Surveys, and experience in the supervision of staff is essential.

The post is established, pensionable, subject to medical assessment and prescribed conditions. The Council cannot undertake to provide housing accommodation for the person appointed.

Applicants should give particulars of age, education, technical training, qualifications, experience, present salary, present and previous appointments which, together with the names of two referees, must reach the undersigned not later than noon on Saturday, 6th October, 1951.

J. E. R. CARSON,
Clerk of the County Council.
Cambrian Chambers, Aberystwyth. 4370

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BOROUGH ENGINEER AND SURVEYOR'S DEPARTMENT.

Applications are invited for the following posts:—

ASSISTANT ARCHITECT (General). Salary within Grade A.P.T., VI (£645-£710 per annum), plus London "weighting" allowance (£30).

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Forms of application with Conditions of Appointment may be obtained from the Borough Engineer and Surveyor, West Lodge, Bexleyheath, to whom completed applications must be returned by Friday, 5th October, 1951.

Canvassing, directly or indirectly, will disqualify.

W. WOODWARD,
Town Clerk.
4378

CAMBRIDGESHIRE COUNTY COUNCIL.
COUNTY PLANNING DEPT.

Applications are invited for the appointment of a PLANNING OFFICER on Grade A.P.T., VIII, of the National Joint Council's Scales (salary £735 to £810 per annum).

Candidates should hold the qualifications A.R.I.B.A. and A.M.T.P.I., and be able to drive a car. A wide knowledge of modern planning technique will be required, and previous experience in a planning office will be an advantage.

The successful candidate will be in charge of the design aspect of the County Development Plan, including the preparation of schemes for village development and central area redevelopment. He will also be expected to advise on housing layouts and general landscape design.

The appointment is subject to the provisions of the Local Government Superannuation Act, 1937, the Council's Conditions of Service, to the successful candidate satisfactorily passing a medical examination, and to three months' notice on either side of termination of appointment. Financial assistance, up to £2 weekly for a period not exceeding six months, may be given if the person appointed cannot obtain housing accommodation and has to maintain his own present residence in addition to the expense of lodgings in Cambridge.

Applications, stating age, past and present appointments (with dates), experience, qualifications, present salary and the names of two referees, should be received by the undersigned not later than the 15th October, 1951.

CHARLES PHYTHIAN,
Clerk of the County Council.
Shire Hall, Castle Hill, Cambridge. 4358

AUCKLAND HOSPITAL BOARD, N.Z.

Applications are invited from Registered and suitably experienced Architects, with qualifications such as B.Arch., A.R.I.B.A., A.A.I.A. or A.N.Z.I.A., for the position of ASSISTANT ARCHITECT.

Commencing salary NZ£850 per annum, by annual increments of NZ£30 to NZ£910 per annum plus the 15 per cent. General Wage Increase.

Accommodation is not provided.

Conditions of Appointment and Form of Application obtainable from the office of the High Commissioner for New Zealand, 415, Strand, London, W.C.2.

Applications, addressed to the Secretary, close at the office of the Board, Kitchener Street, Auckland, New Zealand, at noon on Monday, 29th October, 1951.

R. F. GALBRAITH,
Secretary.
4394

CORBY DEVELOPMENT CORPORATION.

Applications are invited from well qualified persons for the appointment of CHIEF ARCHITECT, at a commencing salary within the range of £1,500-£1,700, according to experience and qualifications.

Candidates must have had considerable experience in the design and execution of large scale housing operations and other buildings for local authorities, and the necessary staff organisation and control. Town Planning experience, though not essential, may be an advantage.

The appointment is under the direction of the General Manager, and is expected to involve large scale construction projects associated with the development of a New Town.

The successful candidate will be required to pass a medical examination, to contribute either to a Superannuation or an Assurance Scheme, and to carry out such duties as the Corporation may require.

Applications, stating age, education, training, qualifications, experience, past and present appointments and salaries, together with the names of two persons to whom reference may be made, must be received by the undersigned not later than Monday, 15th October, 1951. Envelopes and applications should be clearly endorsed "Chief Architect."

R. F. BROOKS GRUNDY,
General Manager.
Corby Development Corporation,
The Stone House, Corby, Northants. 4369

THE UNIVERSITY OF LIVERPOOL.
ROSCOE CHAIR OF ARCHITECTURE.

The Council of the University of Liverpool invites applications for the Roscoe Chair of Architecture.

Further particulars may be obtained from the undersigned by whom twelve copies of applications (one in the case of overseas candidates) should be received not later than 17th November, 1951.

STANLEY DUMBELL,
Registrar.
4298

QUANTITY SURVEYORS
UNITED KINGDOM AND FRANCE.
IMPERIAL WAR GRAVES COMMISSION.

Applications are invited from suitably qualified candidates for posts of Assistant Quantity Surveyor in London and in the French district.

Candidates should be F.R.I.C.S. or A.R.I.C.S. (Quantities) or, in the case of those whose early experience has been with a builder or contractor (in addition to any whole-time study in a recognised school), have passed a written examination in Quantity Surveying. All candidates should have professional experience on structures of important architectural value. Salary within the scale £575 × £25—£750 × £30—£900, entry at £575 at age 25 (slightly less below that age) and up to £810 at age 34 or over.

A knowledge of the French language is desirable for the post in France.

In France there is, in addition to salary, a temporary variable allowance at present at £180 per annum for a single man and £320 per annum for a married man.

Applications to be addressed to Appointments Officer, Imperial War Graves Commission, Wooburn House, Wooburn Green, High Wycombe, Bucks., within 14 days of the appearance of this notice. 4403

ISLE OF ELY COUNTY COUNCIL.
COUNTY ARCHITECT'S DEPARTMENT.

Applications are invited for the undermentioned appointments on the staff of the County Architect:—

(*a*) FIRST ASSISTANT ARCHITECT, Grade A.P.T. VI (£645—£710 per annum).

(*b*) SECOND ASSISTANT ARCHITECT, Grade A.P.T. Va (£600—£660 per annum).

(*c*) JUNIOR ASSISTANT, Heating and Engineering Section. Salary in General Division, rising to £425 per annum at 30 years of age.

The appointments are permanent and are subject to the provisions of the National Scheme of Conditions of Service, the Local Government Superannuation Act, 1937, and to the passing of a medical examination.

Applications for (*a*) and (*b*) are to be made on forms of application obtainable from the County Architect, County Hall, March, and must be accompanied by copies of not less than two recent testimonials.

Applications for (*c*) stating age, education and experience are to be made in the applicant's own handwriting and should be accompanied by copies of not less than two recent testimonials.

Applications for all posts must reach the County Architect not later than Monday, 15th October, 1951.

R. F. G. THURLOW,
Clerk of the County Council.
County Hall, March.
18th September, 1951. 4406

HORNCHURCH URBAN DISTRICT COUNCIL.

Applications are invited for the appointment of ARCHITECTURAL ASSISTANT in the Engineer & Surveyor's Department at a salary in accordance with Grade I of the scale of salaries laid down by the National Joint Council for Local Authorities Staffs (£440 × £15—£485).

Full particulars of the appointment and form of application may be obtained on application to the undersigned, by whom applications must be received not later than Saturday, 6th October, 1951.

P. L. COX,
Clerk of the Council.
Council Offices, Hornchurch. 4405

BOROUGH OF BLYTH.
BOROUGH ENGINEER'S DEPARTMENT.

Applications are invited for the appointment of a JUNIOR ARCHITECTURAL ASSISTANT. The salary for the appointment will be fixed within Grade II, £470, rising to £515, or Grade III, £500, rising to £545, of the A.P.T. Division, according to experience and qualifications.

Candidates should have passed the R.I.B.A. Intermediate Examination or its equivalent.

The appointment is subject to the Local Government Superannuation Act, 1937, one month's notice on either side, and the successful candidate passing a medical examination.

Applications, endorsed "Junior Architectural Assistant," stating age, qualifications and experience, must be delivered to the undersigned, with copies of three recent testimonials, not later than 1st October, 1951.

Canvassing will disqualify, and applicants should disclose relationship with any member or official of the Council.

THE COUNCIL WILL PROVIDE HOUSING ACCOMMODATION TO THE SUCCESSFUL APPLICANT, IF REQUIRED.

EDWIN W. CARTER,
Town Clerk.
"Dinsdale," 75, Marine Terrace, Blyth, Northumberland. 4397

COUNTY BOROUGH OF BARNSLEY
BOROUGH ENGINEER AND SURVEYOR'S DEPARTMENT.
APPOINTMENT OF

(*a*) CHIEF ASSISTANT ARCHITECT.
(*b*) SECOND ASSISTANT ENGINEER.
(*c*) THIRD ENGINEERING ASSISTANT.

Applications are invited for the above appointments on the authorised establishment. Appointments (*a*) and (*b*) in accordance with A.P.T., Grades VI-VII, £645-£760. Appointment (*c*) in accordance with A.P.T., Grade V, £570-£620.

Appointment (a):

Preference will be given to candidates who are Associate Members of the Royal Institute of British Architects and have had considerable experience in Local Government, preferably with a County Borough.

Appointment (b):

Candidates must be Associate Members of the Institution of Civil Engineers and/or should have the Testamur of the Institution of Municipal Engineers, as well as considerable experience in general Municipal engineering work.

Appointment (c):

Preference will be given to candidates who have either a University degree, or are Associate Members of the Institution of Civil Engineers or hold the Testamur of the Institution of Municipal Engineers, as well as having experience in a Municipal Engineer's office.

The appointments will be subject to the Scheme of Conditions for A.P.T.C. Services to the General Conditions of Service within the Corporation as varied from time to time, and to the provisions of the Local Government Superannuation Act, 1937.

The successful candidates will be required to pass a medical examination, and the appointments will also be subject to one month's notice on either side.

If necessary, housing accommodation may be offered to the successful candidates.

Applications, stating age, present and previous appointments, experience and qualifications, etc., together with the names of three referees, should be addressed to the Borough Engineer and Surveyor and Planning Officer, Town Hall, Barnsley, to reach him not later than Saturday, 13th October, 1951.

Canvassing will disqualify, and applicants should disclose in their applications whether or not to their knowledge they are related to any member or senior officer of the Council.

A. E. GILFILLAN,
Town Clerk.
Town Hall, Barnsley.
September, 1951. 4399

HAMPSHIRE COUNTY COUNCIL.

Applications are invited for the appointment of a TECHNICAL ASSISTANT, on Grade III of the National Scales (£500-£545), to work in the South-East Area Office of the County Planning Department at Gosport. Candidates should have passed the Intermediate examination of the Town Planning Institute or of a related professional body, have had experience in the Planning Department of a Local Planning Authority, and be competent land surveyors. In the event of an applicant being appointed who does not hold the requisite qualifications, the appointment will be made at a suitable point in Grade I-II of the National Scales, pending the passing of the requisite examination. The appointment is pensionable and will be subject to a satisfactory medical report.

Officers using their own cars when travelling on County Council duties will receive travelling allowances on the County Scale for the time being in force. In approved cases the County Council are prepared to assist newly appointed staff to meet removal expenses.

No form of application is issued, but applications, stating age, education, qualifications and experience, together with a copy of one testimonial and the names and addresses of two persons to whom reference may be made, should be sent to the County Planning Officer, Litton Lodge, Clifton Road, Winchester, not later than the 10th October, 1951.

G. A. WHEATLEY,
Clerk of the County Council.
The Castle, Winchester.
September, 1951. 4396

LONDON ELECTRICITY BOARD.
SUB-AREA BUILDING SUPERINTENDENT.

Applications are invited for the above position in the Southern Sub-Area Construction Branch at Beckenham, Kent.

Applicants must have had an approved training in the Building Industry, and by subsequent experience be capable of preparing estimates and specifications, planning building construction work and supervising building work carried out by direct labour or under contract. The successful candidate will be responsible to the Sub-Area Construction Engineer for the supervision of general building work in connection with substations in particular; also for general maintenance works in connection with all classes of building within the Sub-Area.

The cost is graded under Schedule "A" of the National Joint Board agreement (17th February, 1950) as Class K, Grade 7, £825 6s. per annum, rising to £863 2s. per annum, inclusive of London area allowance.

Application forms obtainable from Establishments Officer, 46, New Broad Street, E.C.2, to be returned duly completed within 7 days of receipt. Please enclose addressed envelope and quote Ref. V/1325/A on all correspondence. 4415

PEMBROKESHIRE COUNTY COUNCIL.
COUNTY ARCHITECT'S DEPARTMENT.
APPOINTMENT OF TEMPORARY CLERK OF WORKS.

Applications are invited for the temporary post of Clerk of Works in connection with new school buildings, at a salary in accordance with Grade IV, Miscellaneous Division, of the National Conditions of Service, *i.e.*, £400×£15—£415×£25—£440×£15—£470 per annum. The appointment will be subject to the above-mentioned Conditions of Service, to the Local Government Superannuation Act, 1937, and to the passing of a medical examination, and will be terminable by one month's notice on either side.

Applicants must have a thorough practical knowledge of all branches of the Building trade and be competent to supervise building work during course of erection.

Applications, on forms to be obtained from the County Architect, County Offices, Haverfordwest, and accompanied by copies of two recent testimonials, should reach the undersigned not later than 4th October, 1951. Canvassing, directly or indirectly, will be a disqualification.

H. LOUIS UNDERWOOD,
Clerk of the County Council.

County Offices, Haverfordwest.
20th September, 1951. 4414

CIVIL SERVICE.

QUANTITY SURVEYORS and ASSISTANT QUANTITY SURVEYORS are required throughout the United Kingdom by the Admiralty, War Department, Air Ministry, The Ministry of Works, The War Damage Commission, and occasionally overseas by the Admiralty, Air Ministry and War Department. Although these are not established posts some of them have long-term possibilities, and competitions are held periodically to fill established vacancies.

Salaries for these professional posts in London for officers over 26 years of age range from £500 to £750 per annum in lower grades and from £750 to £1,000 per annum in the higher grades. They are slightly lower in the provinces. Salary on entry will be in accordance with age, qualifications and experience.

Vacancies also exist for Quantity Surveying Assistants and others having some experience in a quantity surveyor's office, at salaries ranging from £300 per annum upwards.

Applicants should write, quoting ref. J.Q.S. to Room 368, Ministry of Labour and National Service, Technical and Scientific Register, York House, Kingsway, London, W.C.2. 4428

GLOUCESTERSHIRE COUNTY COUNCIL.
COUNTY ARCHITECT'S DEPARTMENT.

Applications are invited for the appointment of ASSISTANT ARCHITECT, on A.P. and T., Grade VI (£645-£710 per annum). Candidates must be qualified members of the R.I.B.A., with not less than 4 years' experience with a local authority.

The appointment will be subject to the Local Government Superannuation Act, 1937, and will be terminable by one month's notice on either side. The successful applicant will be required to pass a medical examination before appointment.

Applicants should state whether or not they possess a motor car and/or hold a driving licence.

Applications, stating (1) name and address, (2) married or single, (3) age, (4) qualifications, (5) present position, salary and date of appointment, (6) previous positions with dates and salaries, (7) names and addresses of two persons to whom reference can be made, should be sent to S. E. Urwin, F.R.I.B.A., County Architect, Shire Hall, Gloucester, not later than Monday, the 15th October, 1951.

GUY H. DAVIS,
Clerk of the County Council.

Shire Hall, Gloucester. 4417

COUNTY BOROUGH OF BARNSLEY.
BOROUGH ENGINEER, SURVEYOR AND PLANNING OFFICER'S DEPARTMENT.
APPOINTMENT OF GENERAL PLANNING ASSISTANT.

Applications are invited for the permanent appointment of General Planning Assistant, at a salary in accordance with A.P.T., Grade II (£470×£15—£515 per annum).

Applicants should have passed or should be studying for the Intermediate Examination of the Town Planning Institute or its equivalent, and preference will be given to candidates who have had previous experience in a Planning Office, and who have been engaged in the preparation of Development Plans.

The appointment is subject to the National Scheme of Conditions of Service and to the provisions of the Local Government Superannuation Act, 1937, and the successful applicant will be required to pass a medical examination.

The appointment will also be subject to one month's notice on either side.

Applications, stating age, present salary, present and previous appointments, experience and qualifications, etc., accompanied by copies of two recent testimonials, should be addressed to the Borough Engineer, Surveyor and Planning Officer, Town Hall, Barnsley, to reach him not later than Saturday, 20th October, 1951.

Canvassing will disqualify.

A. E. GILFILLAN,
Town Clerk.

Town Hall, Barnsley.
September, 1951. 4416

COLLEGE OF TECHNOLOGY AND COMMERCE, CARDIFF.
Principal: Dr. A. Harvey.
WELSH SCHOOL OF ARCHITECTURE.

Applications are invited for a SENIOR LECTURER and STUDIO INSTRUCTOR to be responsible for part of the advanced work in Design and Construction of the diploma and the degree courses. Candidates must be Associates of the R.I.B.A. and have high academic qualifications. Some professional experience is essential and good teaching experience desirable.

The salary will be in accordance with the 1951 Burnham Report, *i.e.*, £1,000×£25—£1,150. The post is open equally to men and women but the salary quoted is that for men.

Forms of application, together with further particulars, may be obtained from the undersigned, to whom they should be returned as soon as possible.

ROBERT E. PRESSWOOD,
Director of Education.

City Hall, Cardiff.
September, 1951. 4404

MINISTRY OF WORKS.

There are vacancies in the Chief Architect's Division for ARCHITECTURAL ASSISTANTS and LEADING ARCHITECTURAL ASSISTANTS, with recognised training and fair experience. Successful candidates will be employed in London and elsewhere on a wide variety of Public Buildings, including Atomic Energy and other Research Establishments, Telephone Exchanges, and Housing.

Salary: Architectural Assistants, £340-£575 per annum; Leading Architectural Assistants, £570-£675 per annum. Starting pay will be assessed according to age, qualifications and experience. These rates are for London; a small deduction is made in the Provinces.

Although these are not established posts, some of them have long term possibilities, and competitions are held periodically to fill established vacancies.

Apply in writing, stating age, nationality, full details of experience, and locality preferred, to Chief Architect, Ministry of Works, Abell House, John Islip Street, London, S.W.1, quoting reference WG10/BS. 4304

COUNTY BOROUGH OF BARROW-IN-FURNESS.
BOROUGH ENGINEER AND SURVEYOR'S DEPARTMENT.
ASSISTANT ARCHITECT, GRADE VI.

Applications are invited for the permanent post of Assistant Architect, Grade VI (£645-£710 per annum). The commencing salary will be fixed within the grade having regard to the qualifications and experience of the successful candidate.

A Council house is available if required by a married applicant.

Candidates should be competent Architects, with experience on either housing or schools. Associateship of the R.I.B.A. will be an advantage.

Further particulars, conditions of appointment and forms of application may be obtained from the Borough Engineer and Surveyor, Town Hall, Barrow-in-Furness, to whom completed applications must be returned not later than Monday, 8th October, 1951.

LAWRENCE ALLEN,
Town Clerk.

Town Hall, Barrow-in-Furness.
12th September, 1951. 4392

SOUTHERN ELECTRICITY BOARD.

Applications are invited for the following post:—

SENIOR DRAUGHTSMAN.

Sub-Area Engineer's Department, Bournemouth. Salary N.J.B. Schedule D, Grade 5 (£500—£600 per annum). N.J.B. Conditions of Service.

Candidates should have had training and experience in the design and construction of buildings and civil engineering works of an industrial type generally, and in addition, although this is not essential, some experience in the construction of electricity showrooms and offices. Experience in taking off quantities, preparing bills of quantities and of checking building and civil engineering contractors' accounts is essential.

The successful candidate will be required to contribute to the B.E.A. and Area Boards' Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, 1, Priory Road, Bournemouth, and returned to him not later than 9th October, 1951.

F. W. KEMPTON,
Secretary.

26th September, 1951. 4407

CHESHIRE COUNTY COUNCIL.
COUNTY PLANNING DEPARTMENT.
APPOINTMENT OF FORESTRY AND LANDSCAPE ASSISTANT.

Applications are invited for the above appointment which is on the headquarters staff of the County Planning Department, at Chester.

Applicants must be members of the Institute of Landscape Architects or the Royal Institute of Chartered Surveyors (Land Agency Sub Division), or hold a degree or certificate in Forestry. The salary payable will be in accordance with A.P.T., VIII, *i.e.*, £735-£810 per annum, and the commencing salary will be £735 per annum.

The appointment is a permanent one and the successful candidate will be required to submit a satisfactory medical certificate.

Application forms together with full details and conditions attaching to the appointment, may be obtained from me on the receipt of a stamped and addressed foolscap envelope.

The last date for the receipt of completed applications is Wednesday, the 17th October, 1951.

KENNETH O. MALE,
County Planning Officer.

Bridgegate House,
Lower Bridge Street, Chester. 4426

EASINGTON RURAL DISTRICT COUNCIL.
ENGINEER'S DEPARTMENT.

Applications are invited for the following permanent appointments:—

(*a*) SENIOR ARCHITECTURAL ASSISTANT, Grade A.P.T. VII (£685—£760).

(*b*) ARCHITECTURAL ASSISTANT. Grade A.P.T. VI (£645—£710).

Applicants for both appointments must have had previous Municipal experience, have been trained in the office of a Municipal Engineer, Architect or Surveyor, be experienced in Municipal Housing and general architectural work, and have the qualifications specified by the National Conditions of Service.

The Council have development proposals for a modern seaside resort, including swimming pool, major recreational buildings and catering establishments and also complete proposals for redeveloping ten small townships between 5,000 and 12,000 inhabitants as a complementary scheme for the new town of Peterlee.

The appointments are subject to the National Scheme of Conditions of Service and the Local Government Superannuation Act, 1937. The successful applicant in each case will be required to undergo a medical examination.

If required, housing accommodation will be provided.

Forms of application may be obtained from the undersigned, and must be returned endorsed for the appointment for which application is made, and accompanied by copies of two recent testimonials, to reach the undersigned not later than first post on Thursday, 11th October, 1951.

J. W. GRAY,
Clerk of the Council.

Council Offices, Easington,
Co. Durham. 4429

NEW SOUTH WALES UNIVERSITY OF TECHNOLOGY.
SENIOR LECTURER IN ARCHITECTURE.

Applications are invited for the post of Senior Lecturer in Architecture, School of Architecture, New South Wales University of Technology, Sydney. Salary £A1,113—£A1,263 p.a. commensurate with qualifications and experience.

Applicants should possess a degree or diploma of a recognised University, preferably with Honours, and should have had appropriate professional and teaching experience and be prepared to undertake research in their special fields. The appointee will be required to lecture in Building Construction, Theory of Structures and Constructional Design. The normal academic year at the University of Technology consists of 41 weeks.

The appointee will be eligible, subject to medical examination, to contribute to the State Superannuation Fund which will provide an annual pension up to £A713 on existing salary.

The first-class ship fares of the appointee and his family to New South Wales will be allowed and the salary will commence when the appointee takes up his duty in New South Wales.

Six copies of applications stating age, educational career, experience and other qualifications (also six copies of any supporting documents) should reach the Agent General for N.S.W., 56, Strand, London, W.C.2, not later than the 30th November, 1951. No special forms of application are available. 4430

NATIONAL COAL BOARD.

Applications are invited for the following appointments in the Architect's Department of the National Coal Board, Durham Division, at Gosforth, Newcastle-upon-Tyne, 3:

(*a*) ARCHITECTS, Grade I (£700×£25—£875 p.a.). To be fully qualified Architects of sound experience, keen designers, and capable of taking complete charge of projects and control of subordinates.

(*b*) ARCHITECTS, Grade II (£450×£25—£700 p.a.). To be fully qualified and have some experience.

The posts are full time and superannuable. Appointments will be made within the scales at levels in accordance with experience and qualifications.

Applications, stating grade applied for, age, education, qualifications, appointments held and salaries, to be submitted within 14 days to the Establishments Officer, National Coal Board, Durham Division, "D" Floor, Milburn House, Newcastle-upon-Tyne. 4395

Architectural Appointments Vacant

4 lines or under, 7s. 6d.; each additional line, 2s.

BOOTS PURE DRUG CO. LTD., NOTTINGHAM.
ARCHITECT'S DEPARTMENT.

Applications are invited for the appointment of ARCHITECTURAL ASSISTANTS to the permanent staff of the above department. Applicants should have had several years experience in an architect's office and be capable of carrying out a job from sketch plan to building stage. Thorough knowledge of building construction and ability to prepare neat, accurate drawings is essential. Ability to calculate to steel and reinforced concrete structures and to prepare attractive sketch plans desirable.

The department has in hand works of a very varied nature including new chemical works, laboratories, experimental farms, office buildings, housing, schools, generating plants and retail shop premises, etc. Permanent and progressive appointment for the right men who will be required occasionally to visit works in progress of building fn all parts of the British Isles.

A five-day week is in operation and the successful applicant will be required to pass a medical examination and to join the company's pension scheme.

Write stating age, qualifications, training, experience and salary required to: Chief Architect, Boots Pure Drug Co. Ltd., Station Street, Nottingham. 4387

ARCHITECTURAL ASSISTANT, Intermediate standard, required in Architects' office of multiple shop company, interesting work, possibility of permanency. Write Box 4383.

JUNIOR ASSISTANT, about 22 years old, required in London Architect's Department. Must be neat, quick draughtsman, with knowledge of elementary construction and some experience of building surveys. Interesting work, and secure future for suitable applicant. Write, stating age, details of past work, education, and salary required. Box 4382.

JUNIOR ASSISTANT required for Architect's office in London (W.1 area). Interesting work. Progressive appointment offered to keen individual. Salary £350-£450 p.a. Write, stating age, training and experience, to Box 4381.

ARCHITECT'S ASSISTANT required by firm of Architects in South-West England; age 30 to 35. State experience and salary required to Box 4372.

MAX LOCK & ASSOCIATES require a JUNIOR ARCHITECTURAL ASSISTANT, preferably qualified, to work in Bedford office on housing and industrial schemes. Address applications by letter c/o Town Hall, Bedford. 4413

ASSISTANT ARCHITECT required in Railway Office in London. Preferably A.R.I.B.A. Must have had several years' practical experience. Responsible for sketches and working drawings, under supervision. Commencing salary approximately £550 per annum. Apply to Civil Engineer, the Railway Executive, Southern Region, Waterloo Station, London, S.E.1. 4347

ASSISTANTS required for appointments in Architects' Department at Hammersmith. Successful applicants will be given time to acquire background knowledge of non-traditional construction handled by this firm, with a view to assisting with the design and working drawings for projects in the U.K. and abroad. Salary £500 upwards, according to experience. Write, giving details of experience, age, and qualifications, to Staff Architect, George Wimpey & Co., Ltd., 27, Hammersmith Grove, London, W.6. 4398

ARCHITECTURAL DRAUGHTSMAN IMPROVER (aged 17-23) required in Architect's office in West Herts. Write, giving full details of experience and salary required, Box 4402.

BRISTOL Architects have immediate vacancies for SENIOR and INTERMEDIATE ASSISTANTS. Appointments are permanent and progressive. Apply, with details of age, qualifications and experience, to Mackintosh, Beecroft & Partners, 11, Orchard Street, Bristol, 1. 4400

PROGRESSIVE post for LADY ASSISTANT in small private practice, London, W.1. Neat Draughtsmanship, some typing ability required. Box 4401.

APPLICATIONS are invited for the following appointment in the office of the Architect, N.E. Region, Civil Engineer's Office, York:—
SENIOR ASSISTANT ARCHITECT.
Applicants should be Registered Architects and Associates of R.I.B.A. They should be good contemporary designers and able to take responsibility for day-to-day conduct of major contracts.
Commencing salary range £750-£800, according to qualifications and experience.
Applications should be addressed to the Civil Engineer, York, so as to arrive by the 6th October. 4411

ARCHITECT, experienced, required for site office at Leeds University after initial period in London office. Apply full particulars, Lanchester & Lodge, 10, Woburn Square, London, W.C.1. 4412

VACANCY for JUNIOR ASSISTANT, single. Salary £350-£450. Must be good draughtsman, with good practical knowledge of construction. Pension scheme. Interesting and varied work. Gotch, Saunders & Surridge, Chartered Architects, Kettering. 4409

OLYMPIA, LTD., require services of ARCHITECTURAL DRAUGHTSMAN for Exhibition work. Capable of preparing working drawings from designer's sketch plans. Generous salary in accordance with experience and ability. Staff pension scheme. Apply in writing to Chief Designer, Olympia, Ltd., Kensington, W.14. 4408

JUNIOR ARCHITECT'S ASSISTANT required in busy Westminster office, with good prospects of advancement and interesting work. Salary £260 p.a. Box 4419.

ARCHITECTURAL ASSISTANT for practice in Bath. Good practical man required. Office training preferred. All round general experience essential. Academic qualifications not necessary. Salary approximately £350-£425, according to ability. Box 4421.

ASSISTANT ARCHITECT required in West Country by an Organisation engaged on large scale programme of Prefabrication. Candidates should be preferably, though not necessarily, Registered Architects, and should have a good general experience of house design and construction. Salary within Grades VA and VI, according to experience. Pension scheme after probationary period. Box 4423.

ARCHITECTURAL ASSISTANT, man, Intermediate standard, required in Westminster. Varied practice including housing schemes, university and churches. Salary about £7 according to experience. Prospects of promotion. Send full particulars to Box 4434.

VACANCY arises for Articled Pupil (Architectural or Building Surveyors) in City firm. 4435

STRUCTURAL DRAUGHTSMAN, junior, required by progressive chemical manufacturers in East London. The appointment is permanent and progressive and offers excellent opportunities for the right man. Salary according to age and experience, not less than A.E.S.D. rates. Box 4431.

SENIOR ARCHITECTURAL ASSISTANT required immediately. Good salary and prospects. 5-day week. Write to Messrs. J. M. Sheppard & Partners, 38, Bedford Place, W.C.1, giving particulars of age, qualifications, experience and salary required. 4433

Architectural Appointments Wanted

REGISTERED ARCHITECT of exceptional ability and experience, with reputable employers both home and overseas, seeks position of responsibility with firm producing industrial schemes, public buildings and works, etc. Taking special Final Examination in November. Box 247.

MALE ARCHITECTURAL ASSISTANT (24), Inter. and Final standard, 5 years' full-time training, seeks post, 15 miles Bath or Bristol area. Box 237.

CAPABLE ARCHITECTURAL ASSISTANT, 5th year student, 5 years varied office experience, seeks responsible position in London or Middlesex. Box 253.

ASSOCIATE (woman) 3 years' office experience requires position in London area. Box 252.

WORK'S ARCHITECT would represent reputable Specialist Contractor, to Architects and Local Authorities in Birmingham and Midlands. Box 4425.

CHARTERED ARCHITECT, with wide experience, including contemporary London practice, desires responsible appointment. Box 254.

STUDENT (Polish nationality), recently completed the 5-year course at Architectural School (exempt from Intermediate examination), seeks position in London. Private office. Box 250.

A. R.I.B.A. requires part-time situation. Three days per week. Box 4422.

B. ARCH., A.R.I.B.A. (27), 18 months' private office experience, desires position London area. Please write Box 255.

Other Appointments Vacant

4 lines or under, 7s. 6d.; each additional line, 2s.

CLERK OF WORKS required in Wrexham. Duration of contract thirty months. Extensive experience in steel framing and reinforced concrete buildings essential. Box 4410.

SOUTHERN RHODESIA. — Experienced DRAUGHTSMAN for office leading Architect. Salary £400 to £600, according experience. Further details from Overseas Technical Service, 5, Welldon Crescent, Harrow, quoting Ref. OSS.23/3. 4418

Services Offered

4 lines or under, 7s. 6d.; each additional line, 2s.

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