Registered No. M. 5257.

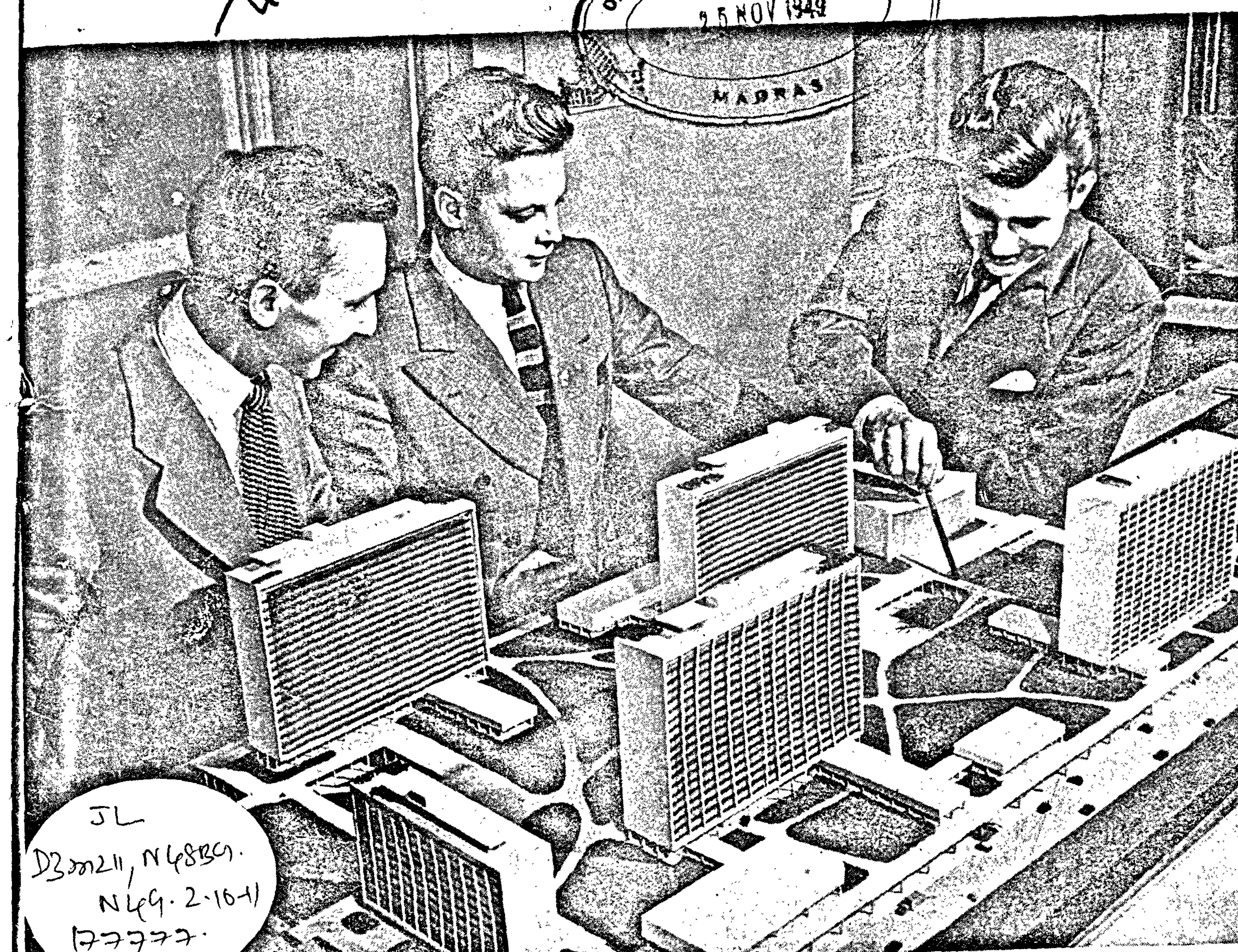
EDITED BY T. N. SUBRAMANIAM, A.F.S. (ENGLAND), PRINTED BY K. M. KURIAN AT THE GORDON PRESS, MADRAS-5
AND PUBLISHED BY T. RAJARAM FOR THE ASSOCIATED BROTHERS LIMITED, MADRAS.

THE BUILDING GAZETTE

Vol. II
Number 11

NOVEMBER 15, 1949

Price 9 Annas
Annual Subscription : Rs. 6



THE ART SCHOOL, PRATT INSTITUTE, U.S.A.—STUDENTS OF ARCHITECTURE STUDY A MODEL OF A CITY BLOCK.

BUILDING TRADES EXHIBITION

is the unique National Show Room where materials and equipments will be on display for 3 days from January 15, 1950.

This exhilarating exhibition is to take place for the first time in Madras at St. Mary's Hall, Armenian Street, which is the most central place in the city.

The British Council, British Information Services, and United States Information Services are all participating in this event.

The floor space is very limited and hence if you also intend participating in this event, please write to us in time and avoid disappointment.

• • •

HERE IS THE PROGRAMME FOR THE

1950 EXHIBITION

AT

ST. MARY'S HALL

Armenian Street, MADRAS-1.

ON JANUARY 15th, 16th and 17th.

WHY NOT PLACE YOUR

MATERIALS and EQUIPMENTS

ON DISPLAY FOR

MR. & MRS. PUBLIC

Particulars can be had of:

The Building Gazette,

1/11, Mukker Nallamuthu Street,

G.T., Madras.

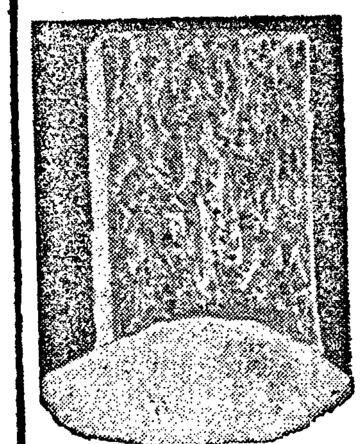
You HAVE SEEN THIS

- ON YOUR PILLARS
- ON YOUR DOOR-FRAMES

DRY ROT!

All due to fungus attack. It starts generally where wood is in contact with earth or masonry — where ventilation is lacking. Pre-treatment with HARDIPROOF renders timber immune. Treatment with HARDIPROOF is simple and cheap.

..*and* YOU'VE SEEN THIS!



- IN YOUR FURNITURE..
- IN YOUR FARM HOUSE

Just a small patch of fine powder at the foot of a cupboard or piece of furniture— a sign that borers are at work. Examination will show the tiny holes from which it comes. An application of HARDIPROOF CONCENTRATED (Green) will prevent reinfestation with the next life cycle of the borer. For furniture use HARDIPROOF WATER-WHITE.

You are being Robbed!

Each year kisans and householders incur great loss because of the ravages of these pests. If you are wise you will take the simple precaution of using HARDIPROOF to counter this loss.

HARDIPROOF CONCENTRATED is guaranteed to contain 20% of Copper Naphthenate and can be dipped, brushed or sprayed. It is insoluble in water. When dried, it may be painted over without bleeding through.

HARDIPROOF

ONE GALLON OF HARDIPROOF WILL COVER APPROXIMATELY 320 SQ. FEET

Manufactured by

ADDISON'S PAINTS & CHEMICALS LTD.

MADRAS-11

AUTHORISED DEALERS

MALABAR

Goray Sridhar & Co. (Regd.), Calicut.

•

NELLORE, GUNTUR, KISTNA, EAST & WEST GODAVARI AND VIZAGAPATAM

General Agencies (Circars) Ltd., Rajahmundry.

•

TANJORE, PUDUKOTTAH, SALEM, NORTH & SOUTH ARCOT, CHITTOOR, & CHINGLEPET (Including Madras City)

The Essential Engineering Corporation, Madras.

•

MYSORE, SHIMOGA, KADUR, CHITALDRUG, TUMKUR, HASAN, SOUTH KANARA & COORG

Mr. N. P. Bharamiah, Mysore.

•

COIMBATORE

N. Veeraswamy Chettiar, Mettupalayam.

•

TRICHINOPOLY, MADURA RAMNAD & TINNEVELLY

Madura Enamel Co., Madura.

•

NILGIRIS

Addison & Co. Ltd., Wellington.

•

KURNOOL, BELLARY, ANANTHAPUR, BANGALORE, AND CUDDAPAH

Addison & Co. Ltd. Bangalore.

•

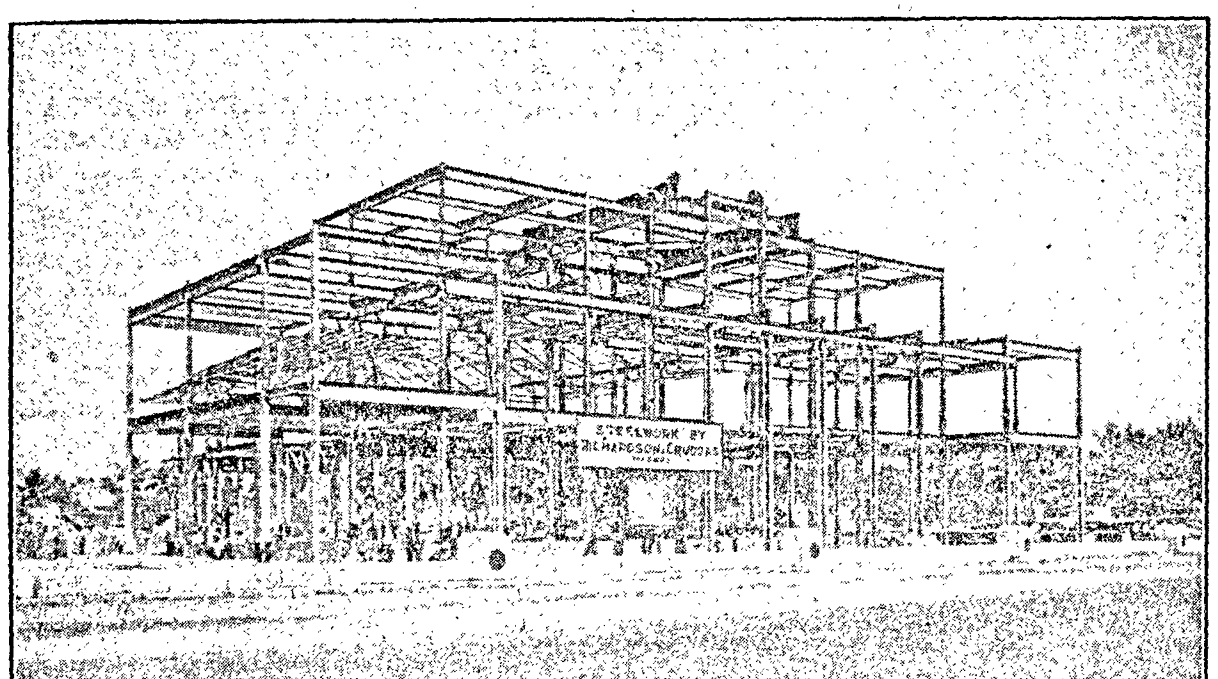
HYDERABAD STATE, CENTRAL PROVINCES & BERAR

Jawahir Trading Co., Secunderabad Dn.

•

EAST PUNJAB & U.P.

Addison & Co. Ltd., New Delhi.



THE BUILDING GAZETTE

AN INDEPENDENT MONTHLY JOURNAL DEVOTED TO THE INTERESTS OF BUILDING INDUSTRY

VOLUME II | NOVEMBER 15, 1949 | NUMBER 11

Articles, photographs, and drawings with a view to publication will be carefully considered. All such articles and illustration should bear the name and address of the sender, and postage should be sent to cover their return if desired in the event of non-acceptance. All communications on Editorial matters should be addressed to the Editor, and all those pertaining to Advertisements to the Manager, THE BUILDING GAZETTE, 1/11, Mukker Nallamuthu Street, G.T., Madras.

SUBSCRIPTION RATE IN INDIA, PAKISTAN, BURMA & CEYLON IS Rs. 6 PER ANNUM. SINGLE COPIES As. 9 EACH. POST FREE.

THE BUILDING GAZETTE is published on the 15th of each month. Complete copy instructions and Blocks for Advertisements must reach the Office not later than the 31st of the month preceding that in which the advertisement is to appear.

THE BUILDING GAZETTE

1/11, MUKKER NALLAMUTHU STREET

G.T., MADRAS.

EDITED BY T. N. SUBRAMANIAM

Associate, Faculty of Surveyors of England

PRINCIPAL CONTENTS

BUYERS' GUIDE

ARCHITECTURAL APPRECIATION

One of the causes for lack of civic consciousness is that while we democratically say that we want to raise our Standards of Living, anyone who learns nothing about architecture at school leaves definitely crippled as a civilised being.

We need to do everything we can to improve and civilise the child's background—its environment—step by step with what we do for the child itself in a practical way instead of packing him with only historical dates of architecture.

We must have our schools designed from an aesthetic point of view and not merely cheapness and utility of accommodation. Instead of making the beginning at attractive edifices and appropriate environments we start making millions of lectures at adults grown up from nasty slums.

We must adopt a functional design in layouts and the surroundings purposeful.

Architects must function not merely as designers and builders but as the chief directors of a movement towards visual beauty. No doubt such a movement will necessarily be very slow, and the final results might be disappointing to those who are used to ugliness and who do not appreciate beauty.

Children as much as parents are interested in new constructions, in the things that are actually going on or are going to go on. It is in that we must make a beginning of approach for appreciation. For there is nothing that some child or other has not collected or started to collect, and with photography and local surveys and gathering together illustrations and so on, we can "stalk" architecture in that way very effectively. And for this the leadership should emanate from the Indian Institute of Architects.

Don Marquis, an American philosopher in his book, *The Almost Perfect State*, says:

"The purpose of the universe is play. The artists know that, and they know that play and art and creation are different names for the same thing, a thing which is sweats and agonies and ecstasies. The artists, who know more than anyone else about play, which is art, which is creation, must be the leaders and the guides, and this earth must submit itself humbly and receptively to the creative spirit. The people of this earth must learn to listen to their artists and make them their guides and governors in all things, and come to realise that to give heed to anyone *but* the artist on any subject whatsoever, is damned nonsense."

NOTES & TOPICS

Nehru's Talks Abroad.

Some of Pandit Nehru's talks abroad might be of direct interest nearer home. Speaking at the Overseas Press Club in New York, Pandit Nehru told Americans, he would like to have some men of outstanding technical experience to take charge of over-all planning of India's various hydro-electric schemes.

In Boston most of his interviews were with U. S. technical experts. It is most important, said Nehru addressing the Indian students at Massachusetts Institute of Technology, "not only that our country should advance along known technological lines but that our technicians should show initiative and add to the existing fund of knowledge."

"Sometimes, people are apt to dwell too much upon India's past greatness. That is not the correct outlook. We must perfect our sciences, and learn the most modern technique."

Addressing a group of Indian students in Chicago Pandit Nehru said: "The next few years will be a difficult period for us. It is upto you students particularly students of the engineering and technical sciences to sustain the great industrial and development projects that we have in hand. Every one of you should try to be a first rate man capable of discharging responsible duties. There is no place for second rate technicians in India today."

Madras Improvement Trust.

It is interesting to follow the progress of the Madras City Improvement Trust since its inception some three years ago. The first Chairman was an engineer who had specialised in irrigation works but fortunately he did not stay long. His successor was one with several qualifications and one with an intimate knowledge of the city. At the assumption of this office he made a tour of study in Calcutta, Kanpur, Lucknow, Delhi and Hyderabad. He was just on his feet setting out to do something when the retirement of the Chief Engineer, Highways has necessitated his recall to this department. An experience got at the instance of the Trust is thus going to disuse. Still as the successor to the present chairman is not yet announced it would be worthwhile to ponder over the qualifications of a person who could profitably occupy this office. Judged from the objects of Improvement Trusts, a person with the qualifications as A.R.I.B.A., A.M.T.P.I., F.R.I.C.S. would be a wise choice.

Fluorescent Lamps.

Fluorescent lamps are fast replacing incandescent lamps in factories, shops and homes for better lighting at lower energy cost. Many of these flourescent lamps contain beryllium, which is highly poisonous. Cases have been reported in the U. S. A. of berillium poisoning due to cuts received from broken fluorescent tubes. In case infection due to beryllium develops, the only course is to remove surgically all the infected tissues. In the States, people are being widely warned about the care to be taken for disposal of old fluorescent tubes. Should a tube break people should leave the place immediately till the dust settles down. The broken glass should be swept up carefully with a broom. Do not touch by hand. Use goggles to protect your eyes while sweeping. If possible wet the broom before sweeping. Gloves should be used to protect the hands. The best method of disposing of used tubes is to bury them.

The Institute of Builders of India.

The newly formed Builders' Association, namely, the Institute of Builders of India has elected Dr. S. Kamesam, an international expert on Timber, as its first President. It is well-known there is only one professional institution in India so far and hence this body fills a real need, in the building industry. Members of this body are required to show proof of high qualifications before their election to the Institute which goes to show that its members will really form a nucleus of consulting engineers and which requires a real organization to properly husband the country's resources.

Slum Clearance in Towns: Bombay News.

Slums in all cities and towns and some selected villages in the Province are proposed to be cleared under a scheme sanctioned by the Bombay Government. The scheme envisages preparation of "master plans" for all cities and towns, and for this purpose the Bombay Government have sanctioned Rs. 4 lakhs for the appointment of additional staff in the Office of the Consulting Surveyor to Government to prepare these plans.

The staff includes three senior assistants, six junior assistants, twelve surveyors, three junior draftsmen and four tracers.

It is intended to survey, at least, six towns every year for the preparation of "master plans", but the scheme is gradually to be applied to the whole of the Province, so as to include in it even villages with a population of 2000 and above. The proposals made in the plans are to be executed by the local authorities concerned, but Government may give loans to these bodies to enable them to incur expenditure to replan their areas.

River Valley Schemes.

Economy is the paramount consideration at the present juncture and when directives are issued from the Centre as well as the Provinces, two points must be remembered to be kept in view. The first is that every scheme is assigned a priority dependent on its All-India significance and not merely on its local importance. Secondly, once a project is started must be allowed to continue without budjet-cuts lest the morale of the project-staff will be much affected. Atleast one major project must be pushed ahead with all speed so that experience thus gained could be utilised on similar projects. Further we need not have to search for so many experts from overseas.

Steel-Saving Committee.

A meeting of the Steel-Saving Committee, appointed by the Institution of Engineers, India, was held on 27-10-1949, at 8, Gokhale Road, Calcutta. Dr. A. H. Pandya presided.

Cement Production in Madras.

The production of cement in Madras Province has risen to 56,000 tons in September compared to the monthly average of 30,000 tons. The allotment of cement to this Province for distribution has been increased by 50 per cent from 16,000 tons to 24,000 tons per month. Factory-war production figures are as follows: Madukkarai 18,000 tons; Dalmia 20,000; Andhra Cement 2500; India Cements, 8000; and Krishna Cements 7500. Total 56,000 tons.

Provincial Steel Allotments.

A quota of 6,000 tons of steel for the first quarter of 1950 has, it is learnt, been allotted to provinces which have schemes for the construction of houses for displaced persons under execution.

According to the allocation made by the Ministry of Rehabilitation, West Bengal gets the biggest share of 1000 tons, while U.P and Bombay get 600 tons each. The other allocations are: Rajpura Development Board, Rajpura 500 tons; Sindhi Resettlement Corporation, Bombay 710 tons; Central P.W.D., New Delhi 2013 tons; East Punjab 290 tons; C. P. and Berar 100 tons; Rajasthan, 100 tons; Bihar 50 tons; Bhopal 30 tons; and Sourashtra 7 tons.

Tractor School at Jaipur

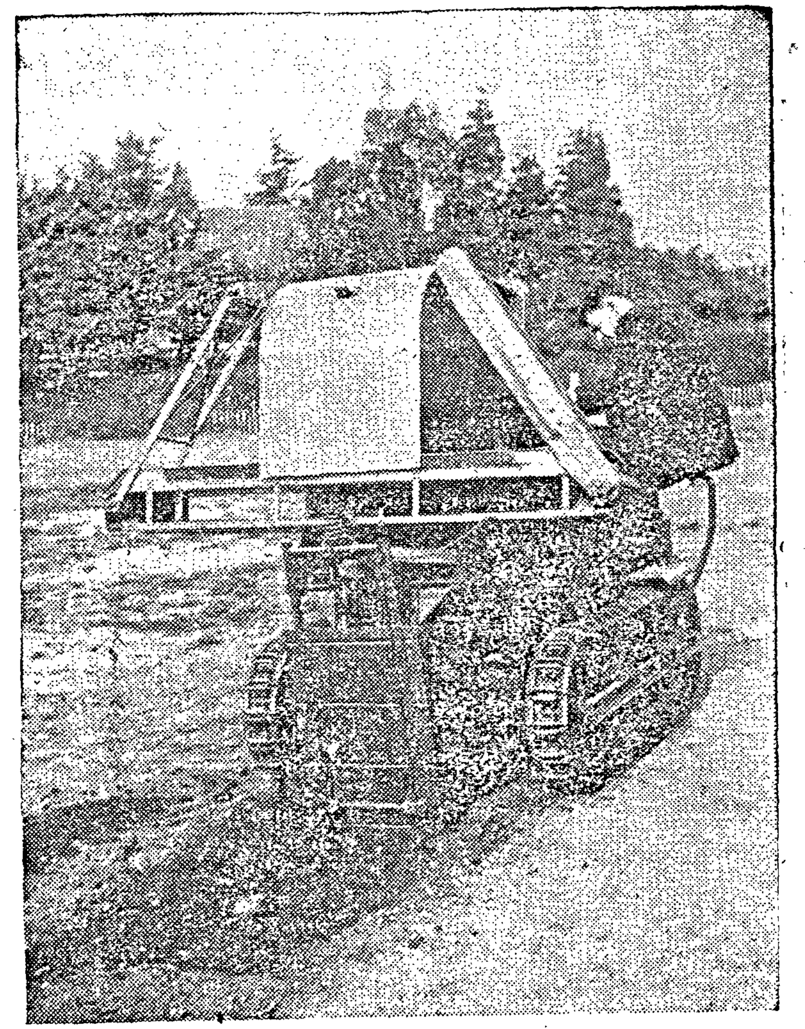
The Kamani Engineering Corporation Ltd. have made arrangements to institute a two-months training course in tractor mechanisation at Jaipur.

Types of International Roads.

The Sub-Committee on Road Transport appointed by the United Nations Economic Commission for Europe has divided roads into three categories according to their width. The first category will comprise roads consisting of one carriageway 7 metres in width with two lanes 3.5 metres wide (mountain roads in this category may be only 6 metres in width). The second category will consist of roads at least 7 metres wide with two carriage-ways separated by a central strip, with shoulders, stabilised where necessary. The third category will comprise roads 10.5 metres wide or, exceptionally, of 9 metres with three lanes.

Cyclists have not been forgotten, the Sub-Committee taking the view that cycle tracks should be built outside the carriage-ways wherever the density of cycle traffic makes this necessary. In this connection, the Danish and Netherlands Governments have promised to build special tracks along all international roads. The French, Swedish and United Kingdom Governments all estimated future cycle traffic on the international roads at 500 cycles per day, whereas the Swiss Government's forecast is 700 per day.

NEW DITCHER



Designed primarily for excavating house footings, the new British-made junior model of the Barber-Greene vertical ditcher, seen here giving a demonstration at the "Building Week" celebrations in England during which many new types of constructional equipments and materials were on show.

DETERIORATION OF LARGE DAM STRUCTURES

THE deteriorating influences acting on large dams of the United States Bureau of Reclamation and the measures taken to minimise their effects were summarised in a paper presented at the recent United Nations Scientific Conference on the Conservation and Utilisation of Resources. The following are extracts of the paper which was given by L. N. Mc Clellan, Chief Engineer of the Bureau :—

Potential deterioration of concrete dams exists in the foundations whether it be in the form of water channels through rock seams or instability of the rock formation. The deterioration of structures from foundation causes may be manifested by excessive under-pressure or uplift, solution, piping, poor support or leakage through the abutments.

If sufficiently intense, the uplift or under-pressure at the base of a dam may cause serious damage or even failure to the structure. The value of continued watchfulness of under-pressure was demonstrated at Hoover Dam, where pressure under the base of the dam rose gradually as the reservoir filled until the pressure exceeded the straight line gradient from reservoir to tailwater assumed in the design. The under-pressure was relieved by drilling supplementary drain holes in the downstream high-pressure area and deepening and grouting the upstream drain holes. Additional drain holes were then drilled downstream from this deep grout curtain and the pressures were reduced to a point where they were well below those assumed in the design.

Abutment leakage is present in nearly all high dams. This may not be serious, but if not controlled it may become progressively worse, leading eventually to piping or under-mining. At Owyhee Dam, a 417ft. high arch-gravity structure in eastern Oregon, leakage developed in the felsite rock of the left abutment that aggregated about 15 cubic feet per second at maximum flow. Despite the fact that the dam was built in disturbed volcanic formations, this leakage was successfully reduced to a safe value before damage occurred by deepening and regrouting the cut-off curtain beneath the dam and extending the curtain several hundred feet into the leaking abutment. To illustrate the nature of the rock, it may be of interest to point out that more than 29,000 sacks of cement, or about 35 carloads, were used for grouting one hole.

When discussing the causes and prevention of deterioration of concrete dams, a distinction should be made between the problems associated with massive gravity and arch dams, and the more highly stressed thin-section reinforced concrete buttress dams. Deterioration that may be merely unsightly in a massive dam may be critical in a thin-section dam. However, because our experience is more extensive with the massive-type structures, this discussion will be confined to the massive-type dams.

Cracking and Weathering

The principal types of deterioration of massive concrete dams are cracking and weathering. Cracking is an important deteriorative effect because it destroys the continuity of the structure, causes leakage and creates a vulnerable spot which may lead to further deterioration. Cracking is usually associated with volume change resulting from the development and dissipation of the heat of the hydrating cement in the concrete. To minimise this temperature and volume change, the Bureau of Reclamation has reduced the quantity of cement in concrete mixes on a number of large structures, has used special low-heat cements, and has installed cooling pipes to remove the heat from the concrete and prevent excessive temperatures in the mass concrete.

If concrete dams were placed as one mass from one abutment to another without joints, transverse cracks would extend completely through the structure. This is demonstrated by Altus Dam, a gravity structure 110 ft. high and 1,112 ft. long, in Oklahoma, which contains only four transverse joints. It had been planned to dissipate the heat in this structure by placing the concrete in shallow layers during the cold part of the year, but the necessity of obtaining early storage of water for irrigation forced the placement of thicker layers during the summer. In the resulting cooling and shrinking, transverse cracks varying from fine openings to $\frac{3}{8}$ in. open cracks were formed at an average interval of 40 ft. throughout the dam. These cracks were later filled with grout to prevent leakage and to ensure continuity of this structure.

It is our usual practice to prevent random cracking in massive concrete dams by placing contraction joints throughout the structure and controlling the temperature of the mass. At each contraction joint, pipe systems are embedded so the artificial crack can be filled with cement grout after the temperature of the concrete has been reduced to final stability.

Most concrete dams are built in successive lifts of about 5 ft., and one of the construction problems is the prevention of leakage at the horizontal construction joints between lifts. This leakage is the result of improper clean-up at the top of the lift and of inadequate bond with the succeeding lift. Unless the top surface of each lift is thoroughly cleaned, a plane of weakness will be formed which may allow water to pass. An impressive example of deterioration caused by leakage through construction joints is Gerber Dam, an 88 ft. high arch dam 485 ft. long. Gerber Dam was constructed in 1925 in 5 ft. lifts. Leakage became apparent soon after the reservoir was filled, and the deterioration of the downstream face of the dam has been progressive since that time. White calcium carbonate deposits leached out of the concrete and weathering of the face was induced by this leakage. Such deterioration may be prevented by thorough cleaning of the construction joints and thorough bonding between succeeding lifts of concrete.

Low-heat Cements

Volume change may be reduced by lessening the heat production of the concrete, and low-heat cements have been successfully applied for this purpose. Some methods of reducing heat production may lead to difficulty in other directions, however. With a view to economy, the Bureau of Reclamation constructed low dams using only about two sacks of cement per cubic yard of concrete. Workability of the concrete was achieved by grinding equal quantities of sand with the cement clinker and using four sacks of this diluted cement per cubic yard of concrete. Arrowrock Dam, a 350 ft. high arch-gravity structure on the Boise River, was constructed using this sand-cement. The concrete surface was of low density and absorbed water spray from the reservoir out-lets to such a degree that the concrete progressively spalled from freezing and thawing attack. The entire downstream face, which had weathered and eroded to an average depth of 1 ft., had to be resurfaced to prevent further disintegration of this structure. To prevent surface deterioration of dams built with low cement contents, our present practice is to use richer mixes at the faces, air entrainment in the concrete, or absorptive form lining or vacuum treatment to secure more durable concrete at the surface.

Another major form of deterioration is the breakdown of the concrete itself. Random pattern cracking on the surface of concrete dams is not unusual and may not be cause for alarm. As distinguished from small-scale crazing or cracking, pronounced map cracking has been attributed to excessive internal expansion which may be aggravated by varying degrees of shrinkage from surface drying.

In some cases deterioration of concrete has been caused by direct chemical reactions between reactive siliceous minerals in the aggregates and the alkalies of the Portland cement. This is an expansive reaction forming conspicuous random pattern cracks which occurred at Parker Dam. Parker Dam was completed in 1938, and two years thereafter the few existing cracks in the structure were discovered to be enlarging and numerous new cracks were observed to appear suddenly and extend themselves rapidly. Fortunately, the cracks so far are largely superficial, as they extend only a few inches into the concrete.

However, in addition to surface cracking such as that at Parker Dam, this expansive reaction between the soda and potassa in cements and certain mineral aggregates has manifested itself in distortion of structures. An example of this is the Stewart Mountain Dam built by a water users' association on the Salt River in Arizona, where the crest of the dam has actually moved upstream about 9 in. and the dam structure has moved away from the power plant located on the downstream toe.

To prevent the occurrence of alkali-aggregate reaction in its dam structures the Bureau of Reclamation selects non-reactive aggregates or restricts the alkali content of cement to be used with aggregates containing known or suspected reactive minerals to less than 0.6 per cent. Aggregates that have been found to react with high-alkali cement include opaline silica, highly siliceous rocks, and acid to intermediate volcanic rocks. It has been found that the addition of pozzolanic materials to reactive combinations of cement and aggregate will reduce expansion. We are currently using this precaution at Davis Dam, which is being built on the Colorado River upstream from Parker Dam where the same reactive aggregates that contributed to the deterioration of Parker Dam are prevalent.

Deterioration of Earth Dams

The earth-fill dam has come into increasing prominence in recent years, and our efforts to prevent deterioration have been intensified as we have had to adapt our water-control structures to increasingly poorer natural dam-sites. In earth dams, it is more often the structure itself rather than the materials of construction that is normally open to the attack of deteriorative forces. Continuity of an earth structure is maintained by the minute frictional and cohesive forces acting between soil grains, and the deteriorative influences acting on earth dams tend to destroy this continuity.

Although earth dams are constructed to hold back water, no earth dam is ever completely watertight. While some soils are more resistant to the passage of water than others, given sufficient time, water will pass through any soil. In doing so, the continuity of the dam can be affected by displacement of the grains of earth in the dam. However, earth dams constructed of uniformly impervious materials are often subject to damage from slides and cracks.

As an illustration, serious deterioration was caused by unbalanced hydrostatic pressure in the embankment of Belle Fourche Dam which was completed in 1911 in South Dakota. This dam was not zoned but was constructed throughout of wetted and rolled clay material faced with 5 ft. by 6.5 ft. precast concrete slabs laid on a 24 in. bed of gravel. In 1931, following rapid drawdown of the reservoir, a slide occurred for about 350 ft. along the upstream face of the 6,000 ft. long structure to a depth of 9 ft. Repair required replacing 63,000 cubic yards of material in the fill. It is now a general practice to prevent such deterioration by locating the most impervious materials in the innermost part of the dam flanked by progressively more pervious materials toward the outer slopes. Such zoning provides adequate weight over the saturated impervious material to resist back pressure.

In the same dam, cracks appeared in 1928 parallel to the axis and several hundred feet in length just back of the crest. Because of prolonged low water in the reservoir, the top portion of the dam had become very dry and cracking was caused apparently by drying shrinkage. To prevent such distress, the top parts of embankments are now constructed of free-draining material which reduces the effect of evaporation and frost.

Wave Damage

The deteriorating forces which attack the surface of an earth fill are wave erosion, wind and freezing. Wave damage is by far the greatest deteriorating surface effect, and a number of devices have been used to reduce wave damage, of which precast concrete slabs and dumped riprap are among the most economical. Waves caused serious slumping of the face slabs at Belle Fourche Dam by washing out fines through joints in the slabs. In more recent structures, transition zones of graded materials, interposed between the coarse surface protection and the fine embankment material, prevent this loss.

Because earth dams are liable to swift destruction through overtopping, precautions are taken to densify the embankment during construction so that its volume undergoes a minimum of settlement. It is equally important that the foundation as well as the embankment attain final consolidation before completion of the dam. However, at Fresno Dam, which was completed in 1939 on the Milk River in Montana, the foundation settled almost 8ft. as the clay materials consolidated under the weight of the embankment, the final one-third of this consolidation occurring in the four years following completion of the embankment. The foundation material at the dam consisted of a clayey silt which contained 20 to 30 per cent. water before it was unwatered by well-points. As settlement measurements indicated no rise of the foundation at the toes of the structure, settlement apparently took place in the clay when the superimposed load consolidated the unwatered stratum. In addition to the designed camber of the embankment to allow for expected settlement, an additional 2ft. of embankment was added following cessation of consolidation, and the dam has been stable since that time.

Appurtenant Structures and Facilities

In the appurtenant structures and facilities for dams, which we depend upon to regulate the release of water for beneficial uses and to control excess flows, water passages must be carefully designed and accurately constructed to avoid the destructive effects of cavitation which result whenever pressures are reduced to the vapour pressure of water. Cavitation may be general, as when the average pressure of water in a pipe is reduced to the vapour pressure, or local when low pressures are induced by a sudden change in the direction of flow.

Thus general cavitation may result when the runner of a hydraulic turbine is set too high with respect to tailwater elevation and extensive pitting of the runner blades results. Similarly, when outlet conduits are designed so that the hydraulic grade line lies close to the upper boundary of the conduit, conditions are ideal for destruction by cavitation. Such a condition was disclosed by model studies of the original design for the Grand Coulee Dam outlet conduits, but they were satisfactorily modified by a redesign to increase pressures throughout the conduit.

Local cavitation can be induced by slight boundary irregularities. In the Arizona spill-way tunnel at Hoover Dam, a hole 112ft. long, 35ft. wide, and 36ft. deep was eroded through the concrete and into the andesite tuff breccia rock, started by a 3in. misalignment in the tunnel lining. The tunnel had discharged only four months at a low flow that averaged 13,000 cubic feet per second. The velocity at the vertical curve, at the foot of an inclined drop of approximately 500ft. where the damage occurred, is about 175ft. per second. The cavity was repaired by replacing the lining with prepacked concrete and removing surface irregularities in both the old and the new concrete.

Investigations made to find the causes of pitting of the needles of high pressure valves disclosed that the pressure of the water was progressively reduced as it passed through the valve, due primarily to change in direction of flow, and when the vapour pressure was reached, pitting resulted. This difficulty was surmounted by redesign of the water passage to avoid low pressure areas. The profile of the needle was modified to prevent separation of the jet from the needle.

Distress in outlets has not been confined to needle valves. Guide grooves in the slide-gates have had to be smoothed and stream-lined to avoid local regions of low pressure following disclosure of damage caused by cavitation downstream from the early designs.

Fast-moving, clear water can erode by cavitation, and given a load of rocks and pebbles for a grinding medium its potentialities for deterioration are tremendously increased. The hydraulic action of the 1,635ft. long spill-way bucket at Grand Coulee Dam, which was designed to dissipate the energy of flows up to one million cubic feet of water per second, caused a ground roll which has carried material from the stream-bed into the bucket where it has eroded the concrete to a depth of 3 in. to 30 in. Extensive repairs are now under way, requiring the use of a specially built caisson for unwatering and concreting successive small portion of the spillway bucket.

TECHNICAL MANPOWER

C. E. PRESTON, M.B.E., M-Eng. (L'Pool), M.I.E.E., M.I.Mech.E., M.I.E.

Head of the Department of Technical and Vocational Education, Hyderabad Government.

I want you to consider with me for a few minutes the problem of Technical Manpower in India. Economic necessity for greater self-sufficiency and the requirements of defence have long demanded a rapid expansion of India's industrial potential. With the adoption of modern methods of agriculture industrial expansion will also be necessary to drain away into industrial occupations the excess of rural population which is exerting such an enormous pressure on the land. The recent devaluation of the pound sterling and of the Indian rupee, which has restricted our purchasing power abroad, only underlines the urgent necessity for India of a greater measure of industrial self-sufficiency.

With a more liberal industrial policy there is no shortage of capital available. New steel plants now being erected will give us one of our most important raw materials for factory construction and for manufacture. The sellers' market in capital goods is already waning, and in a year or two we will be able to get all the industrial equipment we want. What, then, will hold us back? It is the bottle-neck of the shortage of Technical Manpower!

I do not think the *size* of this problem is fully appreciated. An important Indian newspaper recently stated that between 1938 and today the number of those employed in our *organized* industries has risen from 1,750,000 to 2,250,000. If to this we add those who are technically employed in unorganized industries, such as motor garages, small repair workshops, technical maintenance staff, and technicians employed in services other than industry, the present total must be at least 3,000,000. Even that figure means that less than one person in every 100 of the population is in a technical or industrial occupation—a very low figure indeed!

Now it will be fair to assume that about one-sixth of this figure or 500,000 represent the higher executive and supervisory staff, that is, the Directors, Managers, Engineers, Chemists, Architects, Designers, Research Workers, Inspectors, Testers, Draughtsmen and Foremen. The remaining 2,500,000 represent almost entirely the skilled and semi-skilled craftsmen. The average expectation of life in India is 27 years ago, but let us suppose that the technical worker lives much longer and that we can expect him to render an averrge of 25 years of service. Then, even to maintain the present level of industrial personnel, the existing industries must recruit every year 20,000 technical executives and 100,000 skilled and semi-skilled craftsmen.

The technical executives are persons who are trained through University Technical Degree Courses or through Diploma, Overseer or equivalent courses, followed by a period of practical technical training. The annual output of such technical executives from Universities and Technical Institutions at present is about 1,400 from Degree Courses and 1,500 from Diploma and Overseer Courses. To meet the need for this class of personnel the Government of India has already sent over 1,000 scholars abroad for advanced technical education and training in foreign institutions. But to relieve India to some extent of the necessity of doing this in future two Higher Technological Institutions are being established, one near Calcutta and one near Bombay, each for about 2,000 under-graduates and 1,000 post-graduate and research students. Similar institutions are proposed later on for the Northern and Southern regions. In addition 14 of the most important Technical Institutions already existing in the country are to be up-graded and expanded at the cost of the Government of India. After all this has been done it is estimated that the output of technical executives will increase to nearly 4,000 a year from Degree and post-graduate courses and about 1,700 a year from Diploma and Overseer Courses. With the establishment later on of the Northern and Southern Higher Technical Institutions an additional output of approximately 1,300 a year may be expected from Degree and post-graduate courses. The ultimate total output of technical executives is therefore 7,000 a year from all sources as compared with the probable requirement of 20,000 a year. The output from degree and post graduate courses may be sufficient, but the provision of Diploma and Overseer Courses clearly needs expansion many times over. As a first step advantage should be taken of the accommodation and equipment of existing technical institutions to develop rapidly, and on a large scale, the part-time National Certificate Courses recommended in the Sargent Report. Such evening classes will benefit those who have to earn their living during the day, and will require no extra accommodation or equipment. A large expansion in the number of polytechnics is however ungently necessary.

Now we come to the skilled and semi-skilled craftsmen who are trained in a number of ways. The most important of these is apprenticeship in industry itself. Some four years ago the Government of

India conducted a trial survey covering 2,874 of the more important engineering and allied undertakings employing 365,151 persons following 52 different trades. It was estimated that the rate of replacement to maintain a stationary population of technical personnel was six per cent or 21,909 a year. As against this requirement the apprenticeship schemes in these undertakings were only yielding 5,959 trained craftsmen a year on completion of a five years course. Apprenticeship schemes are more highly organized in the engineering industry than in other industries, but, if we take the above survey as typical of industry as a whole, then industry is only providing 27 per cent of its own annual requirement through apprenticeship schemes. That still leaves 73,000 out of 100,000 craftsmen required every year to be met by other means.

Then there are the Government of India Technical Training Schemes providing for the technical and vocational training of 10,500 refugees and 11,000 ex-servicemen through an 18 months course. Assuming that *all* these men complete the course, and that training *could* be regarded as finished in 18 months, this will only give us 14,000 craftsmen a year and leave us a balance of 59,000 a year still to provide.

What other sources are left from which we can obtain skilled craftsmen? There are the industrial and craft schools set up by Provincial and States Governments and private agencies. There is the unorganised apprenticeship of hereditary crafts where the illiterate father teaches his probably illiterate son. I doubt if all these together could produce 9,000 craftsmen a year suitable for employment in modern industry. And we are still left with a deficit of 50,000 craftsmen a year, that is half our total requirement of 100,000 a year simply to maintain the present level of 2,500,000 craftsmen in industry.

Clearly this problem demands solution jointly by the Central, Provincial and States Governments and by industry itself. Four years ago a Government of India Committee proposed an excellent All-India scheme for the training and apprenticeship of craftsmen for industry, in which the apprentice would spend two years in a training centre of trade school followed by 18 months apprenticeship in industry. This scheme should be introduced immediately on a wide scale and apprenticeship legislation should be enacted to ensure the provision of adequate apprenticeship facilities in industrial undertakings.

If Hyderabad is to develop even to the present industrial level of India as a whole, that is one person in technical employment out of every 100 of the population, we should—on the same basis—be producing 1,200 technical executives and 6,000 skilled and semi-skilled craftsmen a year. Actually we are producing less than 100 technical executives and less than 1,000 craftsmen a year.

What then of our dreams of industrial expansion when we are not even training sufficient men to *man* our existing industries? Unless an enlightened public opinion persuades industrialists and governments to invest the large sums required for an adequate system of technical education and training, particularly at the lower supervisory and craftsmen level, our dreams must remain —just dreams!

(With acknowledgements to "*Deccan Radio*" *Hyderabad.*)

FOR DISCUSSION

Today, in view of the magnitude and high importance of the work the spirit of co-operation must become the motive force throughout the entire building industry, from top-man to apprentice.

●

With reversion to the four-class system on India's railways, citizens are left to wonder why last January's controversial and upsetting and much publicised changes were ever made. Still why give such new names to the old Inter and Second classes as Class II and Special Class?

●

The administration of public affairs requires a stern heart.

●

The more things a man is ashamed of, the more respectable he is.

●

Everything that looks to the future elevates human nature; for life is never so low or so little as when occupied with the present.

●

Though it is admitted all round that with the exodus of British and Muslim officers, there has been accelerated promotion beyond all dreams, there are some officers who without increasing the efficiency of their administration, still want one more promotion!

●

Just 37 years ago the agent of an American inventor went to England to offer to a British motor-car firm a self-starter. He was politely shown the door.

●

In the Madras Presidency, heaviest litigation is in Coimbatore district.

●

Morrison-Knudesan & Co. of San Fransisco are the contractors for Gal Oya project in Ceylon.

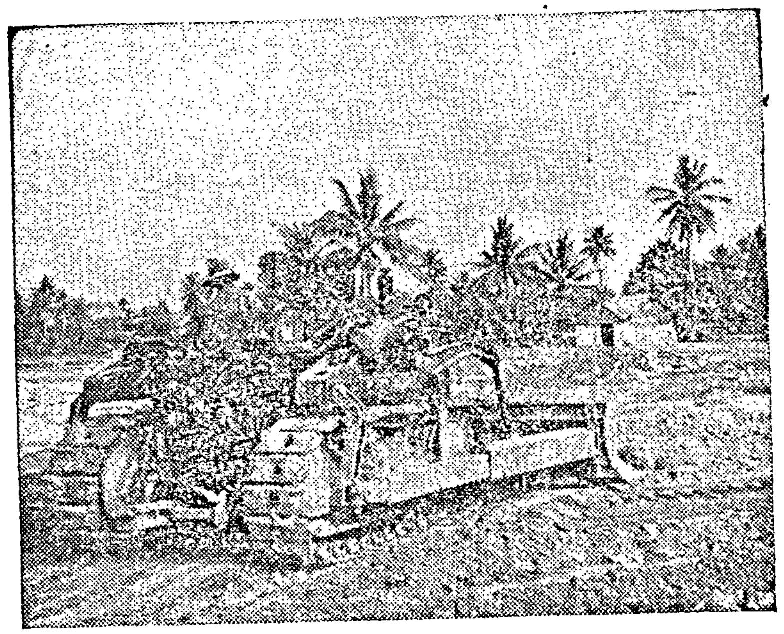
PRACTICAL WAY OF TACKLING HOUSING PROBLEM

AT a time when housing is one of the biggest problems facing the country, it is of special interest to know how a country like Malaya, war-ravaged and not much industrialised, is dealing with the situation. Everywhere the chief obstacle to the housing drive is the short supply of certain essential building materials like cement and steel, as well as the shortage of skilled labour.

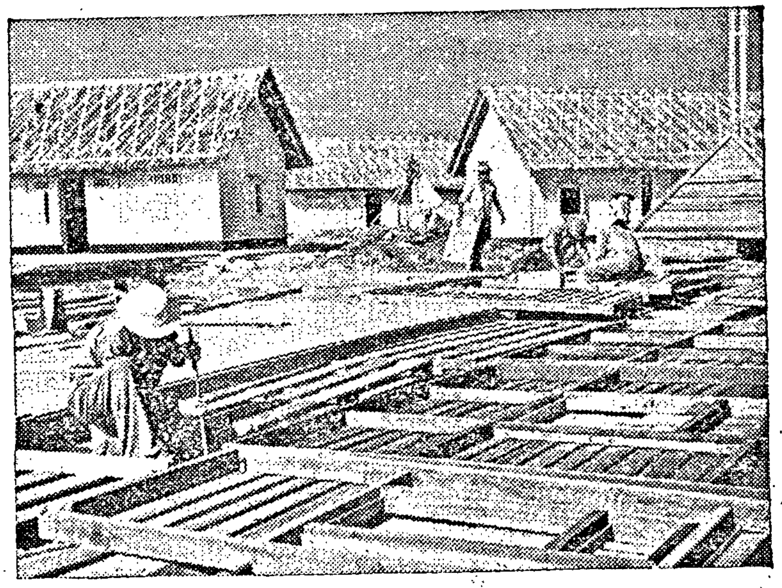
During the war countless houses were destroyed and damaged both in Europe and in Asia; and even in countries which escaped destruction little repairs were done to buildings and few new ones built for dwelling purposes. Against the background of post-war prices and shortages, the task of catching up on six years' arrears of building demands expert planning and efficient exploitation of all available resources, including the use of modern inventions and technical developments.

Practically in every industry mass production is now recognised as the only economic way of producing things in sufficient quantities to meet world demand. The building industry, since the war, has been proved to be no exception to this general rule. The prefabrication technique used to great advantage in building "Bailey" Bridges and "Mulberry" Harbours proved easy of adaptation for constructing prefabricated houses. This, supplemented by the fruits of intensive research, mostly by British Scientists, to find suitable substitutes for certain materials in short supply, has gone a long way in rehousing millions all over the world.

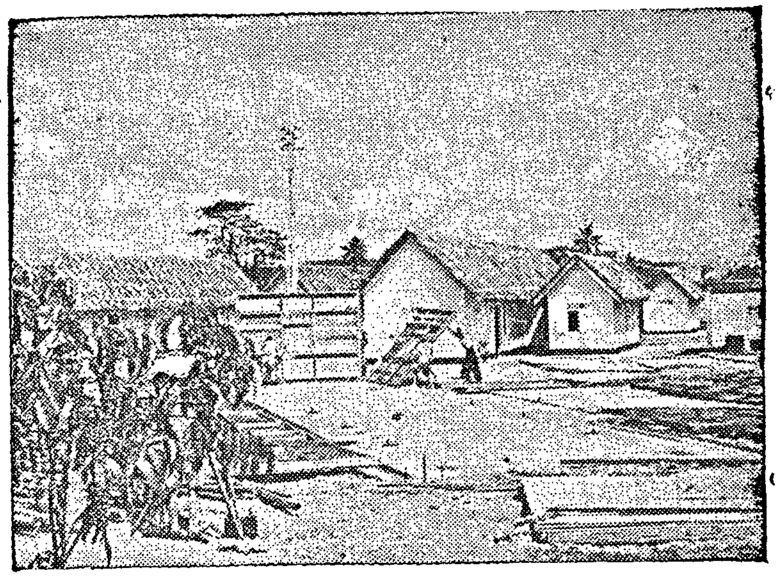
In the very nature of things there can be no uniformity in the matter, for the availability of raw materials



The land is basically swamp, but bulldozers are filling in the swamp—land and adequate drainage is doing the rest.



Component parts are laid out into position ready for assembly.



General view of a site with its Concrete base and the prefabricated sides going up into position.

determines the type of pre-fabs. Where there is plenty of aluminium, for instance, houses can be made in factories using this particular metal. In other places other materials which are locally available have to be used. Climatic conditions have also to be taken into account in determining the type of houses suitable for a place.

In Malaya, where these pictures were taken, houses are usually built of wood, a building material in which the country is rich. To put up a house a Malayan normally buys the necessary wood in bulk, and then skilled artisans work at it for months on end. Very often, as work progresses, the wood bought will be found to be either too little or too much—extra trouble if the former, and waste if the latter. All this long drawn out process of constructing a house and its many worries have now been eliminated by the introduction of the prefabrication technique.

Capt. C.O. Jennings of the Kuala Lumpur Town Board, who is the driving force behind the scheme, has already erected many houses from factory-made parts assembled on the site. To prepare the ground for building sites and to dig trenches for drainage etc. he has introduced many labour saving devices to speed up work. Bulldozers and other constructional equipments have replaced manual labour. The net result is that whereas it previously took months for a number of men to build a house, today the same number of men can produce a house in a matter of days—and speed is of utmost importance in these days when there are so many without a roof overhead. Moreover, the new residential colonies are so well planned that living conditions are very much better than those obtained in older dwellings.

HOW WAS DECEMBER 1949
For Building

A rainy day is one in which 10 cents or more rain is recorded. The following figures show the average rainfall in inches and the average number of rainy days in the month of December based on data up to 1940:—

	Rainfall in Inches	*Number of Rainy Days*
Agra	0.3	0.8
Ahmedabad	0.0	0.1
Allahabad	0.3	0.7
Ambala	0.8	1.5
Asansol	0.2	0.4
Aurangabad	0.3	0.5
Bangalore	0.4	1.2
Bellary	0.1	0.3
Bhopal	0.2	0.5
Bhug	0.1	0.1
Bombay	0.1	0.2
Calcutta	0.2	0.3
Cawnpore	0.3	0.8
Chittagong	0.6	0.7
Cochin	1.6	2.5
Colombo	5.6	7.6
Dacca	0.2	0.4
Gaya	0.2	0.4
Hyderabad	0.3	0.4
Jamshedpur	0.2	0.4
Jhansi	0.3	0.8
Jiwani	0.2	0.8
Jodhpur	0.1	0.3
Jubbulpore	0.4	0.7
Lahore	0.5	1.0
Madras	5.5	5.4
Mangalore	0.5	0.7
Marmagoa	0.3	0.6
Masulipatam	0.7	0.9
Nagpur	0.5	0.8
New Delhi	0.4	0.9
Patna	0.2	0.5
Peshawar	0.7	1.6
Poona	0.1	0.5
Puri	0.2	0.4
Quetta	1.0	2.6
Rawalpindi	1.2	2.3
Sambalpur	0.2	0.3
Srinagar	1.3	3.4
Trichinopoly	2.8	4.5
Trincomalee	13.7	13.6
Trivandrum	2.5	3.7
Vizagapatam	0.6	0.9

BUILDING ON MADE-UP GROUND OR FILLING

*The following are abstracts of notes received from the *Building Research Station of England.*

SUITABLE sites for new buildings and estates in industrial areas are becoming more difficult to find and it is more frequently necessary to build on made-up ground or filling. The problem of deciding on the most appropriate type of foundation for buildings on such sites is therefore assuming greater importance.

In the past the control exercised in filling waste ground has not been such as to ensure that the site would be suitable for the support of buildings with normal type foundations. A fill was always expected to settle under its own weight, the rate of movement gradually decreasing with time, and an appreciable time interval was anticipated before such movements would decrease to within tolerable limits. As a safeguard against subsequent cracking of buildings erected on such sites, it is still customary to stipulate a time interval between the completion of the filling and the erection of a building on it. This interval may vary in different cases from a few months up to twenty or thirty years (or even more) and where such restrictions are based on local experience, they should be given due consideration. When a fill has been given sufficient time to reach its optimum natural consolidation under its own weight the foundation problem obviously becomes simpler. Even so, special foundations may be required if the building load is likely to produce substantial additional settlements.

When it is desired to proceed with construction on a fill and it is not known how far natural consolidation has proceeded, then it becomes necessary to assess the suitability of the fill for the support of buildings and to determine whether special foundations or special structural precautions are required. This problem presents many difficulties and involves the consideration of a number of different factors. It is not possible to lay down general rules and each case needs to be considered on its merits. The present note aims at giving a lead on the points requiring consideration. In connection with the placing of new fills it is emphasized that by careful selection of materials and by the use of modern compaction techniques during placing, it is possible to construct a fill that will provide satisfactory support immediately after placing. However, experience in the use of controlled compaction of fills for building purposes is as yet very limited.

The present note gives a brief summary of:—

1. The factors to be taken into account in assessing the suitability of an existing fill and the design of foundations for buildings on this type of ground.
2. The general principles governing the placing of new fill so that it will give optimum support in a short time.

Existing Fills

The time required for a fill to reach a sufficient degree of natural consolidation to make it suitable as a foundation depends mainly on the following factors: the nature of the material comprising the fill, the depth of the fill, the method of placing, the nature of the underlying natural ground and the drainage conditions. Thus if the history of the fill is known a general assessment of its suitability can be made by considering these factors.

Nature of Materials

A wide variety of materials are used for making fills: among these may be mentioned household and industrial waste materials, such as refuse, brick rubble, ashes, slag, clinker and chemical wastes; mine and quarry wastes; and all types of soil.

The extent to which an existing fill will be suitable as a foundation depends a good deal on the materials that were used to make it, and also on whether the fill is of fairly uniform composition or is very mixed as the result of random tipping.

Considering fills of fairly uniform composition, some materials are much better than others. The best filling materials are those in which:—

(*a*) The particles of the material are hard and durable, and are not subject to decay or breakdown by the weather or chemical attack.

(*b*) The material can readily be placed in a compact and dense condition, so that the consolidation after placing is small and takes place quickly.

The best types of material are those with fairly large particles like hard rock wastes, gravels and coarse sands, which drain readily and quickly become sufficiently dense. If such material is well graded (i.e. contains a proportion of finer grain with the coarser grains) it can be placed in a very dense condition.

The smaller the predominant particle size, the longer is the time required for natural consolidation to take place under the weight of the fill. Thus fills made up of very fine sands, silty soils, inert industrial wastes and the like, if they have

* Crown Copyright Reserved

not been properly compacted during placing, may require a period of years in which to settle. Moreover the bearing capacity of the surface layers of the fill is likely to be smaller than for a fill comprising coarse grained materials.

Fills containing a large proportion of very fine grained material like clay take a very long time to consolidate sufficiently, the actual time depending mainly on the method of placing and the depth of the fill. Deep fills composed of clay loosely tipped have been known to settle over a period exceeding a hundred years. In fact fills containing clay or clay shale, which softens in water, may actually deteriorate for a period after placing. The bearing capacity of the surface layers may also be low.

Fills of mixed composition, especially if they were loosley tipped in random fashion, are likely to give variable support to foundations, a feature which is not good for the building. If the different materials have been placed to the full depth of the fill in segregated areas, the variability of support is likely to be greater than if they had been tipped in uniform horizontal layers over the whole fill.

Mixed fills, when composed of household and industrial wastes, may also contain materials liable to decay or to decompose. Particularly undesirable are such things as old oil drums, tins and metal containers which rust and leave large voids. A large proportion of combustible material in a fill will involve a risk of spontaneous ignition giving rise to underground fires, of which there may be no sign on the surface. The support afforded in such cases is likely to be very variable, especially where cavities have been left during placing or have formed as the result of decay, decomposition, internal combustion or erosion by water. In general, sites of this nature are best avoided for building purposes.

Depth of Fill

For a given material comprising the fill, the total settlement under its own weight increases with the depth of the fill, while the period during which movements take place increases in greater proportion. When the depth of the fill varies over a given site, differential settlements will occur even after the shallow portions of the fill have reached virtual equilibrium. Information on the shape of the filled volume is therefore needed to assess the suitability of the site.

Method of Placing

The method of placing determines the amount of voids left in the fill and hence the amount of settlement which the fill will undergo. Any records giving information on how the fill was placed may therefore be usefull in assessing the probable condition of the fill.

Such methods as end tipping, in which thick layers are deposited in a loose condition, result in unsatisfactory fills unless they are entirely composed of good material, like gravel or hard slowly weathering rock waste. Occasional rolling of the top surface makes very little difference, since this can only compact the upper foot or so and leaves the main body of the fill loose. The common method, placing layers 2 ft. to 3 ft. thick and rolling, is better than loose tipping; but even so, fills containing clay or silt are only partly compacted by this method, and appreciable consolidation under the weight of the fill may go on for some time.

As will be indicated later, the best method of placing is to spread the material uniformly in thin layers not more than 1 ft. thick and to compact it at the water content that will give the greatest density.

Unless it is known that the fill is composed of the best type of material or has been placed by rolling in thin layers, it is always advisable to put test pits down into the fill and by inspection of the side to estimate the extent to which natural compaction has proceeded. The foundation must then be designed to suit the conditions revealed.

If the natural ground on which the fill rests is soft and compressible (e.g. beds of peat or soft clay) the surface of the fill may settle appreciably and unevenly as the result of the weight of the fill consolidating these soft beds below it. These settlements will of course be additional to those resulting from the consolidation of the fill itself. The effect of the additional load of the building in producing further consolidation of such underlying soft ground must also be considered.

Underlying Natural Ground and Drainage Conditions

If the underlying ground is free draining, the consolidation of the fill is likely to be much faster than when the ground is impervious On impervious ground the provision of an adequate drainage layer, at the bottom of the filling would serve a similar purpose.

Site Investigation to Assess Suitability of Existing Fills

Careful examination should be made for indications of the presence of large cavities, such as old pit-shafts, sewers, etc.

A broad assessment of the support likely to be afforded by an existing fill can be made by inspecting the sides of a test pit dug to the full depth of the fill, in order to identify the type of materials in the fill and to see what degree of consolidation has been reached; at the same time the underlying natural ground can be examined. As previously indicated, if the fill is composed of hard granular materials it is likely to give good support. If it contains clay and compressible materials the support given will depend largely on the degree of consolidation. If large voids are found, the support is obviously likely to be poor. If the filling is in a soft condition further settlement is to be expected, but if it has been in place for some time and is found to be solid and hard the support is likely to be satisfactory.

A closer assessment of the properties of a fill may be obtained from field tests and tests on undisturbed samples. Small scale loading tests may give a useful lead if their limitations are borne in mind; such tests reflect only the properties of the layer of fill a foot or so below the test plate and give no idea of the condition of deeper layers. In certain types of fill the resistance to penetration of a probing tool or cone-ended rod may give a useful indication of the condition throughout the depth of the fill.

Although experience in the application of soil mechanics tests to problems of foundations on filling is as yet rather limited, the techniques have been found to be useful in special cases. Quantitative measurements of the *in situ* density of the fill combined with laboratory compaction tests* have proved useful, and so have consolidation tests and shear tests. Whenever the importance of the job warrants it, the application of soil mechanics' methods is recommended.

Some fills, particularly those formed from ashes and industrial wastes, may contain soluble salts such as sulphates, which, dissolving in the ground water, are likely to have a deleterious effect on thin concrete structures, such as sewer pipes. Chemical analysis is advised to check the need for special precautions.

Design of Foundations

For all structures the design of the foundations should aim at keeping differences in settlements within limits that the superstructure can stand without harmful distortion. At the same time either the total settlements should be so restricted, or special arrangements made, as to ensure that connections to the building, such as drains, etc., are not damaged. The type of foundation chosen should be one that will keep the movements as small as possible. If a certain amount of differential movement of the ground cannot be avoided, the foundations taken together with the structure should be made sufficiently rigid to redistribute the load and so to keep the relative settlements of the structure small.

* See British Standard 1377 (1948) Methods of Test for Soil Classification and Compaction.

Special conditions obtain with buildings on fill because settlements may arise from two causes. First there is the settlement due to the weight of the fill which may result from consolidation of soft underlying strata as well as from consolidation of the body of the fill. Added to this there is the further settlement which may results from the additional load of the structure. With deep fills the weight of the fill itself may be the main cause of consolidation, the building load being quite small in comparison. Uneven settlement may then remove support from beneath foundations at places where the surface of the fill settles most, and these places may not bear any relation to those where the building load comes on to the foundations.

In view of the comparatively large and variable compressibility of many existing fills, the foundation problem requires particular attention. It may be necessary to make some allowance for this in designing the structure. For instance, the use of long structures should be avoided, or where possible they should be divided into compact parts to ensure flexibility of the whole. This is specially necessary when parts of the site carry different loadings, as for instance with buildings of varying height or occupancy.

On most fills ordinary pad or strip footings will rarely be adequate, and usually raft or piled foundations are required. Where some degree of uneven bearing cannot be avoided, even though the fill has undergone a certain amount of consolidation, a concrete raft reinforced top and bottom is particularly suitable for light structures such as houses.

Where the bearing capacity of the made-up ground is considered to be good (checked if necessary by loading tests) wide strip footings may be sufficient to distribute the load; they should be well reinforced in both directions and tied to prevent displacement and to increase stability.

If the filling, although affording moderately good support, is thin and overlies a firm natural stratum, it may be preferable to use a beam and pier or beam and pile foundation.

When the fill is loose and of poor supporting value, it is usually best to take the foundations, particularly those of fairly heavy buildings, through to firm natural ground below by means of piers or piles and to carry the structure on beams spanning between them. The beams can be constructed of reinforced concrete or encased steel joists, and should be well tied together and bonded to the piers or piles. In deep fills, which can be readily penetrated, piles are often preferable. In assessing the design loads for such piles, allowance should be made for "negative skin friction" i.e. the downward drag on the piles which will result from consolidation of the fill after the structure is completed.

Special care should be taken with buildings sited near the edges of filled ground; in particular, placing a building partly on the natural ground and partly on fill should be avoided. Instead of this, the foundations should be carried down to the natural ground by piers or piles.

The services of structures placed on existing fills also need very careful attention. While suitable foundations for the structure can readily be designed even on very poor fill, the consolidation which inevitably takes place in the fill may have a serious effect on the services. Indeed, the time restriction commonly stipulated for building houses on fills may be more important in respect to services than it is to the structural foundations. In this problem the relative movement between the building and services entering it is particularly important, but the relative movements between various sections of piping contained in the fill may also require consideration. If the movements are not likely to be large, the use of strong rigid pipes (e.g. cast iron) with flexible connections may be sufficient. In more severe cases it may be necessary to carry the services on piles bearing in a firm stratum below the fill.

Placing of New Fill

With new fills it is first necessary to consider the site on which the filling is to be placed. Whenever possible, surface water in ponds or depressions should be drained away (even pumping away the water may be advisable) and arrangements should be made for the permanent drainage of the whole area. If the natural soil strata are compressible (e.g. peat layers), then it must be expected that the weight of the fill will cause consolidation in these layers and distort the surface of the fill however well it is placed. Time will be required for this movement to take place; alternatively removal of the peat may be considered if this is practicable.

On sloping sites the original ground should be well terraced to ensure general stability, and drainage should be provided throughout the site. The stability of the existing slope should be checked, and the possibility of a landslip being caused by the filling must be considered. The first layer placed in a new fill should preferably be of a granular nature so that it may serve as a drainage layer at the base of the fill. On very soft natural ground such a layer might also be necessary to provide a running surface for vehicles used in placing the fill.

New fills will usually be made with watever materials are available locally, but by disposing the various types of material in a selected manner and by proper compaction it is possible to bring about a very substantial improvement over random filling. Proper compaction during placing can bring a fill into a condition which would otherwise require many years of consolidation. This improved degree of compaction can be got by placing in small lifts, by putting in more work with compaction equipment and by controlling the moisture content of the material at the time of placing. Where a high degree of compaction is required, an engineer conversant with the problems of compaction should be consulted to draw up the specifications for each particular job; but it is possible to give a few general rules that will help with most fill construction jobs.

If the fill consists wholly of hard granular m a t e r i a l, satisfactory support can be readily obtained. Loose layers up to 18 in. thick systematically rolled with a heavy smooth roller will give a sufficient degree of compaction. The water content of the material is not important.

If the fill consists mainly of granular materials but contains a proportion of clay, more care is necessary to keep the water content near the "optimum" (a condition which may be roughly defined as one in which the material will just bind together when squeezed hard in the hand). The layers for rolling should be kept down to 6 inches to 9 inches.

If the fill contains a high proportion of clayey material, extra care is necessary in order to obtain a high degree of compaction. Material excavated as large lumps will need to be broken down. The layers should be spread at about 6 in. thickness, and special compaction equipment may be required. The moisture content should be controlled close to the optimum, and construction during wet spells in the winter should be avoided.

When various types of material are available for a fill they should, where possible, be disposed in horizontal layers over the area of the site. If there is only a limited amount of good granular material, it will be best to use the granular material in layers interspersed between layers of poorer fill. Doing this will reduce the time required for the poorer materials to consoldiate naturally and make the site suitable for building at a much earlier date. With clay fills, the top layer also should consist of good granular material, since this will cut down shrinkage troubles which would arise if the clay was exposed to drying during spells of dry weather.

Finally, although the controlled placing of new fills calls for special construction procedure and involves increased initial cost, it should be given serious consideration where an extensive site is to be filled and a high degree of support for future building operations is required. The higher initial cost needs to be offset against the use of the site for buildings at an earlier stage than would otherwise be possible, thus avoiding a long period as an open space or as an area with restricted use. Furthermore, the better the fill is compacted, the less stringent are the requirements for foundations and services. For fills with a high degree of compaction, ordinary foundations designed on standard principles could probably be used; with a lower degree of compaction the design would need to be based on the principles outlined for existing fills. However, in view of the limited experience in the controlled placing of fills for building sites it is not possible to indicate the degree of compaction that would be economically desirable.

PERSONAL

Dr. S. Kamesam

Dr. S. Kamesam has been elected the first President of the Institute of Builders of India.

Mr. M. S. Thirumalai Iyengar

Mr. M. S. Thirumalai Iyengar, Chief Engineer, Highways, Madras has been elected the President of the South India Centre of The Institute of Engineers, India.

Mr. K. K. Nambiar

Mr. K. K. Nambiar, Chairman of the City Improvement Trust, it is learnt, is reverting to Government Service, as Superintending Engineer, Highways, Madras.

OBITUARY.

Mr. T. P. Gately

We regret to record the death of Mr. T. P. Gately, Superintending Engineer, Central Electrical Circle, C.P.W.D., in New Delhi on October 30, 1949 due to heart failure. Mr. Gately, who was 51, joined the C.P.W.D. in 1924. He carried out the electrical installations in Government House, the Central Secretariat, Council House and several other buildings. He took a keen interest in the activities of the Anglo Indian Association. He was a keen sportsman and was for many years President of the Delhi Race Club and also of the Delhi Hockey Association.

SCIENCE INVADES THE BRICKFIELD

* B. BUTTERWORTH

(*of Building Research Station, Watsford*)

IT will be realised that the brick industry is far from being the most scientifically minded of industries. This has been an inevitable result of the nature of the material and the organisation of the industry. When a large part of the industry consists of units making no more than ten million bricks a year, and when those bricks are sold, as they often were before 1939, for £ 3 a thousand or less, it is easy to see that such firms could not afford to employ even one scientific worker or to equip even a modest laboratory. With a large number of small producers organisation of co-operative research activities has been equally difficult. Naturally, therefore, there has not been the constant analytical and technical control that is common in larger factories making more valuable products such as food or oil, soap or fertilisers, steel or drugs. It has been suggested recently that this difficulty might be overcome by the co-operation of a number of firms in maintaining regional laboratories to serve all the manufacturers in a given area. All this, however, is for the future. At present science can hardly be said to have invaded the brickfield. Rather does it stand with its forces massed on the frontiers and with a few patrols thrust out into this forbidding and still unconquered territory. Let us review the disposition of its forces.

The clays used for making building bricks provide a very difficult field of investigation for the chemist and physicist. It is only recently that a secure theoretical basis has been established for the study of clays. Less than 20 years ago clays were believed to be amorphous colloidal materials, i.e. materials composed of very fine particles having no crystalline form. Now it is known that these very fine particles are minute crystals of a few minerals the composition and structure of which are known, at least in their main features, and which can be recognised by X-ray analysis and in other ways. This advance could have been made only by studying specimens of the purest available clays. The study of the mixtures of clay minerals with many kinds of impurity that are used for brickmaking had to follow a long way behind because the disentanglement of such complex mixtures is far more difficult. As recently as 1935 the well-known German ceramist Dr. H. Salmang wrote in his book "Ceramics, its Chemical and Physical Foundations" that scientific knowledge of bricks is still in its infancy and is thus in inverse ratio to the importance of brick as a building material. He dismissed bricks in three pages.

In the absence of any foundation for a thoroughly scientific treatment, the importance of the material has led to a good deal of semi-scientific work; empirical study of such matters as the strength of bricks, their capacity to absorb water, and their content of soluble salts, a common impurity responsible for efflorescence, the white deposit which is often seen on new brickwork.5 There have also been attempts to explain particular effects, such as the development of certain colours under certain conditions of kiln atmosphere, in terms of chemical reactions. Some of the earliest essays in this direction were made by Dr. H. Seger, the outstanding German ceramist of the second half of the XIXth century. The earliest studies, on any important scale, of the strength and water absorption of bricks were made by engineers at Watertown Arsenal, U.S.A., about 1884.

The growth of interest in scientific and technical matters affecting the clay industries led, about the turn of the century, to the organisation of the first ceramic societies. The American Ceramic Society was founded in 1899, and whilst most of the papers published in its Transactions dealt with pottery and refractories (i.e. firebricks and similar materials for the construction of furnaces and furnace equipment) there was from the first a respectable minority devoted to the properties of building bricks and the methods of brick production. The corresponding body in England, formed in 1900 as the North Staffordshire Ceramic Society and now known as the British Ceramic Society, at first paid relatively little attention to bricks; a Building Materials Section was formed only in 1928. The German Ceramic Society was founded in 1920, though a medium for the publication of technical papers on the subject had existed in Germany since 1876 in the Ton-Industrie Zeitung (Clay Industry Journal) published by the Seger and Cramer Laboratory in Berlin. T.I.Z., however, was not exclusively a ceramic journal, but served also the lime, cement, and gypsum industries. It performed for years the astonishing feat, for a trade paper, of appearing twice a week. There exist also associations of manufacturers and clayworks managers which have their own journals, some of long standing. These journals, however, rarely publish original scientific papers and, whatever their usefulness to the practical man, cannot claim the same scientific standing as the journals of the various ceramic societies. In France the Syndicate of Ceramic Manufacturers maintained its own laboratory, but this is exceptional.

Even in the ceramic society Journals the quality of the papers is uneven. The Journal of the American Ceramic Society is the most consistent. This is because clayworkers in the U.S.A. have opportunities for a much higher standard of technical education than those in England. Many American colleges have courses in ceramic engineering, and their graduates hold many of the responsible jobs in the industry.

* Bricks and Modern Research, Price 10/6. Published by Crosby Lockwood & Son Ltd., London.

Moreover, in the U.S.A. ceramics includes enamel and glass as well as the materials usually included in the British use of the term. The British Ceramic Society's Transactions also contain a good proportion of research papers on pottery and refractory materials in addition to papers that may fairly be described as hints and views by practical men for practical men, but in quality and volume the papers originating from the Building Materials Section are not impressive. Lest this should be thought an unpatriotic depreciation of British technology, let me hasten to take refuge behind the authority of the Committee on the Brick Industry. I quote from their Third Report (p. 6):

"Some indication of the technical outlook of an industry may usually be gained from the facilities available for general training, and from the extent and quality of its literature. The latter is in turn usually to be correlated with the existence, activities and size of membership of its technical societies and associations. There is no chair of clay technology at a British university such as exists at several universities in the U.S.A., and organised courses of instruction in clay technology are few. Courses exist at the North Staffordshire Technical College, Stoke-on-Trent, the Imperial College of Science and Technology, London, the Royal Technical College, Glasgow, and the University of Sheffield, but even in these instances the industries primarily served are the pottery and metallurgical industries. We feel, therefore, that the heavy clay industry labours under a distinct handicap in the lack of adequate training of its future technical personnel, and in this regard may be compared unfavourably with other industries . . . It must be commented that the amount of the original publications arising from the brick industry, or stimulated by it, is very small, and this is a reflection of the amount of original research work carried out by the industry."

To obtain a more exact idea of what lies behind this last statement let us look at the Transactions of the British Ceramic Society for the five years 1935-1939. During these five years 170 papers were published in the Transactions of which 24 dealt wholly or mainly with the products, materials or processes, of the heavy clay industry. On these 24, nine described machinery, works equipment, or processes, nine were summaries of existing knowledge or recommended practice, leaving only six with any claim, however humble, to be regarded as original contributions to scientific knowledge.

So much, then, for the scale of scientific operations in the heavy clay industry. We shall see in later chapters what has been achieved by the labours of the few investigators scattered over several countries who have taken part in them. Progress in related fields has been more encouraging.

We have already seen that there is a more adequate scale of work on the clays used in pottery and fire-brick manufacture. Clays have also been studied by some mineralogists, and agricultural research organisations too have made contributions to our knowledge of the chemistry and physics of clays which will be useful when the problems of the heavy clay industry come to be tackled on an adequate scale. It is to be expected, for example, that the physical properties of clays which influence their resistance to the passage of a plough will also control their flow in a brick machine. Much valuable knowledge of the mechanical properties of clay is also being accumulated in the relatively new science of soil mechanics which studies the resistance of soils to the pressures imposed by the foundations of buildings, the strength of earthworks for dams, the stability of embankments and similar problems.

We can visualize laying all these branches of science under tribute to help us in solving brick problems, because they all deal with materials of the same basic chemical types. The brick clay may contain many impurities, especially iron compounds which, in one form or another, are responsible for most of the colours of burnt bricks, but in spite of the superficial differences arising from this fact a large part of it may be identical with the purer clays used, for example, in making pottery. Its behaviour will therefore be subject to the same laws.

In addition to these affinities based upon the fact that it is made of clay, the clay building brick has another group of scientific relationships arising from that the fact that it is a rigid porous body. It is therefore reasonable to look for help in dealing with another group of clay-brick problems to the work of physicists and physical chemists who have studied the problems of other rigid porous bodies such as natural building stones, concrete, natural and artificial base-exchange materials (which include the base-exchange compounds used in the ordinary domestic water softner), and the oil sands or oil-bearing rocks the porosity of which has been studied by petroleum technologists on account of its importance in estimating how much oil they contain.

However difficult, therefore, research on clay bricks may be, there are tools available for tackling the job, and some of the more modern and powerful of these tools are now beginning to be used on practical problems of interest to makers and users of clay building materials. The new technique is well illustrated in an ambitious scheme launched in Belgium in 1942, in spite of the difficulties of the German occupation. An organisation known as the Comite Belge pour l'Etude des Argiles (COBEA) began a survey of the country's clay resources in which several university laboratories and technical institutions are co-operating. The clay deposits are sampled, the sources of the samples being recorded on large scale maps, and the samples divided among the cooperating laboratories, each of which specialises in some particular line of investigation. The data that are being collected range from X-ray and thermal analyses of the clays, aimed at identifying the minerals they contain, to firing trials which give an idea of the physical character of the burnt product. —*A Review.*

ARCHITECTURE FROM THE GROUND UP

Clifford B. HICKS

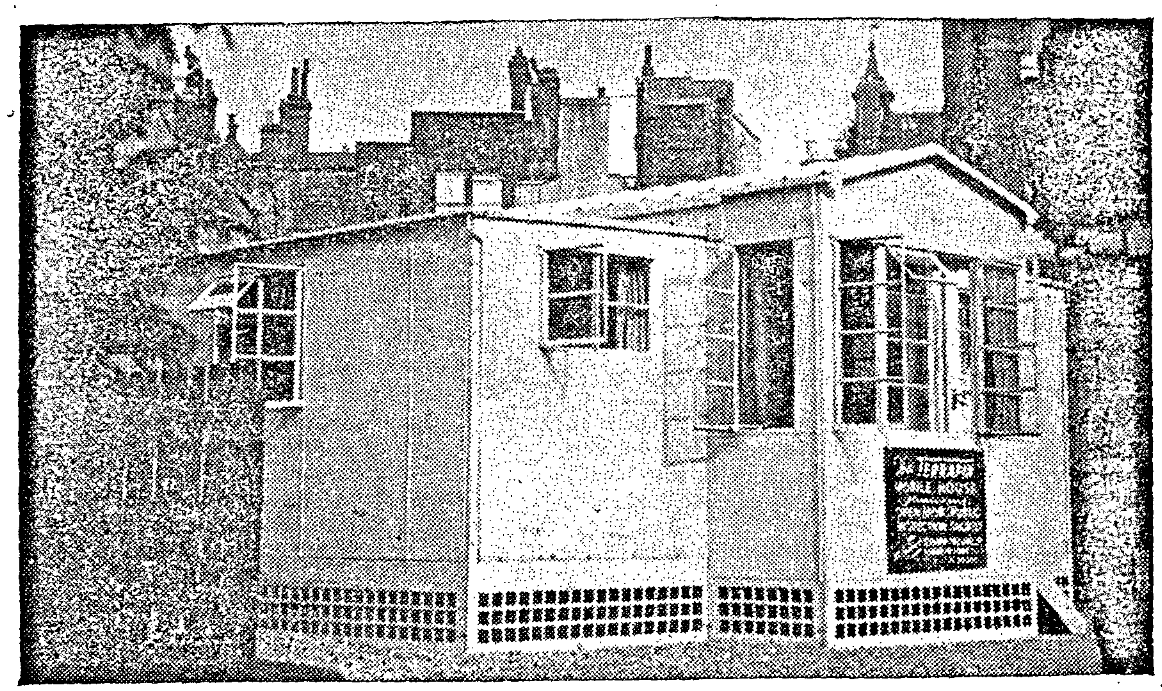
Frank Lloyd Wright, noted American architect, believes that an architect is more than a designer. An architect is a builder to whom tools and materials should be old friends. To prove his idea, Wright not only is building world-famous structures but is building good architects. At Taliesin, in Wisconsin, Wright is the faculty of a unique school for architects. The 55 students in his school this year made their way to Taliesin from 15 different countries to learn his techniques.

Wright is the forthright exponent of a native American architecture. Homes, he says, should blend into the surrounding countryside—should be "wedded to the ground." His estate at Taliesin is an outstanding example of this technique. On a ridge overlooking the Wisconsin River stands Wright's home, a building that seems to grow out of the ground. The home and two older buildings in the valley below house the Taliesin Fellowship, the school which Wright hopes will turn out a generation of architects who are builders, not merely designers. Standing like a symbol on a hill overlooking the school is one of Wright's first architectural projects—a wooden windmill tower which neighbours said would topple in the first storm. It has lasted 50 years.

The school has no faculty other than Wright, no curriculum and no hourly courses. Wright believes that students "learn by doing." His apprentices learn architecture by working with Wright on his projects. They may remain at the school 10 days or 10 years, and when they leave they are given a letter of recommendation instead of a diploma, if their work has been satisfactory. Usually such a letter

(*Continued on page 29*)

THE TERRAPIN MOBILE DWELLING ON VIEW



A revolutionary type of house, the terrapin mobile dwelling, is expressly designed to provide industry with an immediate means of housing workers comfortably and economically where traditional housing is not available. The terrapin can be built in six hours by two or three men. The terrapin mobile dwelling, designed by a London firm, on view to the public in Queen Victoria Street, London.

CONTRACTS OPEN

The dates at head of paragraphs are those for the submission of Tenders. Applications for forms and particulars should be made to the address given at the end.

BOMBAY: Swimming Pool.

Nov. 18.—Construction of a Swimming Pool at Shivaji Park, Mahim. Forms and particulars from the Architect, Greater Bombay, Bombay Municipality Kamani Chambers, Top Floor, Nicol Road, Ballard Estate, Bombay.

HIRAKUD DAM PROJECT.

Nov. 21.—Earthwork 40 crores cft. in excavating Bargarh canal in about 49 miles length and distributories and minors in about 240 miles length. The Executive Engineer, Canal Division No. 1, Sambalpur.

AJMER: Refugee Huts.

Nov. 21.—Construction of 286 Refugee Huts to be constructed at different sites at Ajmer. Approximate cost Rs. 11,40,000. The Engineer-in-Chief, B.B.& C.I. Railway, Ajmer.

BELLARY: Concrete Roads.

Nov. 23.—Cement Concrete Surfacing to Nellore-Bombay Road miles 323/5 plus 972 ft. to 325/3. The Divisional Engineer, Highways, Bellary.

HOOGHLY: Culverts.

Nov. 23.—Construction of Reinforced Concrete Slab Culverts on the Baidyapati—Tarakeswar-Champadanga Road in Hooghly and on the Bolepur Sriniketan Road, in Birbhum. Estimated cost Rs. 5,37,000. The Executive Engineer, Hooghly Construction Division, Chinsurah.

BOMBAY: Aquarium.

Nov. 24.—Construction of Taraporevala Aquarium in Bombay-Part 11-Water circulation and Purification Works. Estimated cost Rs. 97,348. The Executive Engineer, Presidency Division, P.W.D., Secretariat Building, Fort, Bombay.

DELHI: Tube Wells.

Nov. 25.—Sinking of 30 Tube Wells located within about a mile from the Lower Main Line of Western Jumna Canal. The Executive Engineer, Tube Well Division, 9, Upper Bela Road, Delhi.

POONA: Surface Drainage.

Nov. 25.—Provision of Area Drains along Runways, Taxi Tracks and Hard Standings, etc. at R.I.A.F. Poona. Estimated cost Rs. 3,10,000. The C.R.I.E., Projects, Poona.

KAKINADA: Concrete Roads.

Nov. 25.—Cement Concreting mile 0/0 to mile 10/3 of Raja-mundry-Kakinada Road between Dowlaiswaram and Dwarapudi. The Superintending Engineer, Highways, I Circle, Kakinada.

POONA: Laboratory.

Dec. 1.—Construction of Radio Communication Laboratory at the College of Engineering, Poona. Estimated cost Rs. 1,71,000. The Vice-Principal, College of Engineering, Poona.

KIRKEE: Quarters.

Dec. 2.—Construction of Class E Quarters at S.M.E. Kirkee, Poona. Estimated cost Rs. 4.5 lakhs. The Chief Engineer, Southern Command, Poona.

COIMBATORE: Asphalt Roads.

Dec. 15.—Providing Asphaltic Concrete Surfacing to Coimbatore-Pollachi Road in miles 2/1 to 3/0. The Superintending Engineer, Highways, IV Circle, Coimbatore.

PROPOSED NEW WORKS

Madras.

The Government of Madras have sanctioned a scheme, at an estimated cost of Rupees 3.92 lakhs for the construction of 90 additional quarters for Government servants in the Todhunter Nagar Area, based on the latest design evolved by the Buildings Design Committee.

Mysore.

The Mysore Government have sanctioned a revised estimate of Rupees 5½ lakhs to purchase special replacements and equipment for sluices of the Krishnasagar Dam.

Serampore.

The Government of West Bengal have approved the Serampore Municipal Sewerage Project which is estimated to cost Rs. 17,22,700.

JODHPUR: Electricals.

Feb. 28.—Manufacturing, supply, erection, tests and setting to commercial service of Steam Turbines, Boilers, Generators, Power Transformers, Switch-gear and other electrical equipment required for the extension to Jodhpur Power Station. The Chairman, Central Electricity Commission, The Mall, Simla.

EDUCATIONAL

THE INSTITUTION OF STRUCTURAL ENGINEERS

THE Institution of Structural Engineers was founded in 1908 and was incorporated by Royal Charter in 1934.

It is a professional society with a membership of approximately 4,600. Its activities are devoted to the promotion and general advancement of the science and art of structural engineering in any or all of its branches and to the exchange of information and ideas relating thereto amongst the members of the Institution and otherwise. Meetings are held for reading and discussing papers bearing upon structural engineering and relevant subjects, including the constitution, properties and use of materials.

There are nine branches of the Institution, eight of which are in Great Britain. Overseas, there is the Union of South Africa Branch. The Institution issues a journal, *The Structural Engineer*, each month, and other publications.

Examinations are held by the Institution twice a year. In connection with these the following awards are made: The *Andrews Prize* to the most successful candidate in the complete Associate-Membership examination; the *Husband Prize* to the candidate who takes the complete Associate-Membership examination and obtains the highest marks in the paper on "Structural Engineering Design and Drawing", and the *Senior and Junior Wallace Premiums* to (*a*) the candidate taking the whole of the Associate-Membership examination who obtains the highest marks in the paper "Theory of Structures (Advanced)" and (*b*) the candidate obtaining the highest number of marks in the complete Graduateship examination.

Since 1943, the Institution has been engaged in the drafting of Codes of Practice for reconstruction purposes in conjunction with the Ministry of Works, and acts as convener institution for Load-Bearing Superstructures and Earth Retaining Structures.

In addition, the Institution at the request of the Ministry of Works submitted a report on *Reinforced Concrete Structures* published by H. M. Stationery Office.

The address of the Institution is 118, Victoria Street, London, S.W.1.

SPECIFICATION

British Standard for Connectors for timber. (B.S. 1579 : 1949.)

In the past the structural use of timber has been handicapped by the absence of suitable joints which will withstand tension. Recently a number of connecting devices have been introduced with the purpose of increasing the efficiency of tension joints to make them comparable with the strength of the members concerned. A British Standard has now been published dealing with connectors for timber which specifies the quality and dimensions of several types of these connectors. The range covered consists of split rings, shear-plates, claw-plates, toothed-plates and corrugated toothed-rings. In each case the connector unit includes the bolt and the special washers which are required to withstand any tendency of the nut or the head of the bolt to become embedded in the timber.

Copies of this British Standard may be obtained from the British Standards Institution, Sales & Distribution Department, 24, Victoria Street, London, S.W.1., Price 3/- post free.

(*Continued from page 25*)

signed by Wright assures them of a good job or clients of their own.

Students feel that they are working under the guidance of the master architect. In the 50 years that Wright has been an architect of stature he has designed 500-odd homes and buildings, many of them so revolutionary that they have set a new style in architecture. His ideas are best expressed in his homes, which he designs "from the inside out."

One example of his idea is the research building now under construction for the makers of John-son's Wax in Racine, Wisconsin. The structure will be 15 stories high with circular walls of tubular glass. Alternating with the main floors will be circular floors inside the walls. The entire building will be supported by a circular masonry stem extending 50 feet into the ground. According to Wright, the building will be flooded with light and will house the research offices in natural relationship flowing downward.

These are among the many ideas that apprentices at Wright's school are absorbing. The Taliesin Fellowship was founded in 1932 to include the young draftsmen who were working with Wright on his projects. A few of the orginal apprentices work with him to-day, serving as advisers for other students. Others have made brilliant careers in architecture. The Foundation has grown slowly through the years and taken on an international flavor with the addition of students from foreign countries. To-day apprentices from Japan and Palestine are working with T-square and triangle beside young men from China and Egypt. Among the other countries represented are Norway, Ceylon, India and England.

Because the 79-year-old architect believes that a man cannot design a good building unless he knows the nature of the materials from which it will be built, Wright insists that his apprentices build with their own hands. All the buildings of the school have been built or rebuilt by the apprentices. After years of such patient work, according to Wright, students and materials will work together as a team in building new structures.

Apprentices start designing and drafting the day they enter the Fellowship. Whenever a man is assigned a room, he rebuilds it according to his own tastes and requirements. The resulting arrangements are unique. The apprentice actually must live with his own design, and the mistakes he makes he never forgets. Several hours are set aside each afternoon for work on the projects Wright has undertaken. This is essentially a drafting job, as Wright himself works out the idea of the building and draws a floor plan and elevation, whether it is a five-room home or a 50-story hotel. But the apprentice takes over the job of making detailed drawings of the building, and here he expresses his own originality, both in conception and drawing. Wright describes his apprentices as "the fingers of my hands."

In the now-famous workshop of the Fellowship the apprentices carry through another phase of their training, patiently fashioning scale models of the buildings Wright has planned. By the time the students have drawn detailed plans, pored over them for months and built models to exact scale, they are just as familiar with the structure as though they had lived in it.

To live at Taliesin is to live creative architecture from the ground up. Changes in the terrain of the estate are planned and executed by the students. Landscaping to the apprentice has become the art of preserving the natural beauty of an area instead of creating a new setting as a back-drop for a building of foreign design.

Life at Taliesin, either in Wisconsin or Arizona, is a cooperative enterprise to maintain the school. Students tend the garden, prepare and serve the food, wash their clothes, study and work together. Wright also develops the talents of his students in some of the arts allied to architecture. By encouraging his students to express themselves naturally in their work, Wright hopes to train a new generation of architects, men who can build structures that seem a part of the earth itself.

(With acknowledgements to) "*Popular Mechanics*")

CURRENT MARKET PRICES OF MATERIALS

1. Prices vary according to quality and quantity ordered.
2. Those given below are average market prices in Madras.
3. Owing to the unsettled state of market most prices are liable to fluctuate.

CONCRETOR

		Rs.	A.	P.
Portland Cement (Upto 10 bags without permit)	per bag	4	11	3
Blue metal ½" gauge	per 100 c. ft.	56	0	0
,, 1½" ,,	,,	40	0	0
River sand	,,	18	0	0
Reinforcement M. S. Rods ⅝" dia.	per cwt.	18	15	0
,, ½"	,,	19	2	0
,, ⅜"	,,	20	3	0
,, ¼"	,,	22	11	0
Binding wire 16 gauge per lb.		0	12	0
Sealocrete Concrete Surface dressing per gal.		10	0	0
Pittsburg Reinforcements—Welded Fabric	per sq. ft.	0	3	0
	to	0	6	6

BRICKLAYER

		Rs.	A.	P.
Country bricks 2" G.M.	per 1000	28	0	0
Stock bricks 3" T.S.M.	,,	50	0	0
Shell lime	per 100 c. ft.	66	0	0

ROOFER

		Rs.	A.	P.
Malabar Tiles	per 1000	185	0	0
Malabar Ridge Tiles	per 100	75	0	0
Terrace bricks	per 1000	18	0	0
Asbestos Corrugated Sheets	per sq. ft.	0	6	11
Asbestos Trafford Sheets	per sq. ft.	0	6	11
G. I. Corrugated sheets 24 gauge	per sq. ft.	0	4	3

CARPENTER

		Rs.	A.	P.
Burma Teak scantlings	per c. ft.	20	0	0
,, boards	,,	25	0	0
Malabar Teak scantlings	,,	15	0	0
,, boards	,,	18	0	0
Mango planks	,,	4	8	0
Insulation boards ½"	per sq. ft.	0	8	0
Asbestos plain sheets	,,	0	5	1
Wirenails per lb.		0	9	0
Wire-screws ¾" per gross		1	12	0
,, 1" ,,		2	0	0
,, 1½" ,,		2	4	0
Butt hinges cast brass	per pair	2	12	0
Cast brass Cabin hooks 6"	each	1	4	0
Barrel bolts cast brass	per r.ft.	4	8	0
All drop bolts cast brass	each	11	8	0
Plywood 3 mm.	per sq. ft	0	4	3

GLAZIER

		Rs.	A.	P.
Sheet glass 16 oz.	per sq. ft.	0	10	0
,, ⅛"	,,	1	2	0
Plate glass ¼"	,,	4	0	0
Figured glass white	per sq. ft.	0	14	0
,, coloured	,,	1	6	0

IRONWORKER

		Rs.	A.	P.
R.S. Js. 4" x 3" (Controlled rate)	per cwt.	18	14	0
,, 5" x 3" to 15" x 6" ,,	,,	18	8	0
,, 18" x 6" and over ,,	,,	18	14	0
Channels, angles and tees ,,	,,	19	12	0
M.S. plates ,,	,,	20	0	0
Black sheets 20 gauge ,,	,,	22	10	0
G.I. plain sheets 24 gauge ,,	,,	22	10	0
G.I. barbed wire, 2 ply, 12 gauge	,,	39	4	0
Rivets, flat or round head	,,	75	0	0
Steel Rolling Shutters (up to 120 sq. ft.)	per sq. ft.	5	4	0

PAVIOR

		Rs.	A.	P.
White glazed tiles (English)	per doz.	6	8	0
,, (Japanese)	,,	4	8	0
Coloured ,, (English)	,,	8	0	0
Marble tiles ¾" polished white or grey	per sq. ft.	4	0	0
Snowcrete white cement	per cwt.	22	3	0
Colorcrete	,,	29	8	0
Sealantone Liquid flooring green	per gal.	23	0	0
,, red or black	,,	19	0	0

PLUMBER

		Rs.	A.	P.
Squatting pans, English 18"	each	54	0	0
Pedestal closets without seat	,,	45	0	0
W.W.P. Cisterns, 3 gal. (Elephant brand)	each	44	0	0
Sinks 30" x 18" x 10"	,,	158	0	0
W.H.B. 25" x 18" with waste and one tap	,,	118	0	0
Flat urinals, English	,,	56	0	0

PAINTER

		Rs.	A.	P.
Himalayan Dry Distemper	per lb.	0	8	9
Turpentine	per gal.	8	8	0
Double-boiled linseed oil	,,	10	8	0
Raw linseed oil	,,	8	8	0
Copal varnish	,,	8	2	0
Black japan	,,	7	8	0
French polish	,,	11	10	0
Karoit Enamels (all colours)	,,	22	2	0
Goodlass wall paints	per lb.	0	10	9
Glue	,,	0	15	6
Putty	,,	0	12	0
Sandpaper	per doz.	1	4	0

* Readers are advised that enquiries addressed to the Journal will gladly be forwarded to the concerned suppliers of materials or equipments.

If you want

CLEAN GRADED

BROKEN BLUE METAL

FOR CONCRETE

★

Ask

E. GANAPATHY

1/11, Mukker Nallamuthu Street, G.T., MADRAS.

A DILEMMA?

VERY OFTEN THE DISCRIMINATING PERSON HESITATES--TO WHOM TO ENTRUST HIS QUALITY PRINTING. WHETHER IT BE A VISITING CARD, LETTER HEAD, INVITATION, COLOUR LABELS, CARD BOARD BOX MANUFACTURING, DYE-SINKING, COPPER-PLATE, NAME BOARD MAKING OR DESIGNING, LET **GORDON PRESS** *DO IT FOR YOU. THE NEXT TIME YOU ARE FACED WITH THE PROBLEM, PLEASE DO NOT BE SATISFIED WITH ANYTHING BUT THE BEST.*

Please call on or give a ring to:

GORDON PRESS

QUALITY PRINTERS

768/770, Triplicane High Road, Madras-5.

Telegrams: "GOODPRINT"

Telephone: 8156.

BRANCH OF:

THE MADRAS PUBLISHING HOUSE (1945) LIMITED

19, Mount Road, Madras-2.

Telegrams: "GOODPRINT"

Telephone: 84025.

THE "GLOUCESTER" INCUBATOR

The 'Gloucester' Incubator enjoys a record for reliability, having won its way to the present position it occupies through absolute merit. Our post-war models are up-to-date, simple and economical in operation, and you will value these machines for their dependability.

CONSTRUCTION:

Case: Selected imported softwood with plywood panels mortised and tenoned joints. Plywood interior with wool insulation sides and top conserving heat. Nicely finished in a pleasing workmanlike manner. Colour Light Oak. Top Green with aluminium edging.

Heating Unit: Large lagged heater with moisture device. Large lamp reservoir with hinged burner fitted to a slide, making a most simple wick trimming arrangement and connection to the heater flue.

Regulation: By Capsule (tested) which expands or contracts thereby raising or lowering the damper of the Heater. Adjustable by a sliding lead weight.

Thermometer: of English Manufacture, hanging type.

Humidity: Inside moisture trays in addition to moisture device.

Legs: Four stout legs, lamp rests and nursery bar ready for fixing with screws provided.

Instructions: Full working instructions with each machine.

PRINCIPLE OF INCUBATION:

To incubate successfully, Heat, Air and Moisture must be correctly applied and controlled.

HEAT furnishes the means where by the life principles in the incubator commences and is controlled in the 'Gloucester' by the capsule type regulator, which is extremely simple and reliable.

AIR. The sectional photograph shows how fresh hot air enters the Incubator above the egg chamber descending slowly downwards through porous diaphragms being controlled in movement by removable felts, afterwards passing through slots in the bottom of the Incubator.

MOISTURE. As an egg contains all the moisture needed if it is to be incubated under normal conditions the conserving of moisture is the best policy. The 'Gloucester' has two moisture trays in the egg chamber and in addition an exterior drip feed moisture device which allows the Operator to supply additional moisture without opening the Incubator door.

A Nursery below the hatching or egg tray is also provided.

CAPACITY: 100 Eggs: Rs. 405 ex-godown.
" 150 Eggs: Rs. 425 "

T. R. NAGARAJ RAO

39, Linga Chetty Street, G.T., MADRAS.

Registered No. M. 5257.

EDITED BY T. N. SUBRAMANIAM, A.F.S. (ENGLAND), PRINTED BY K. M. KURIAN AT THE GORDON PRESS, MADRAS-5
AND PUBLISHED BY T. RAJARAM FOR THE ASSOCIATED BROTHERS LIMITED, MADRAS.