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AUGUST 20, 1953
Offices: 49, Wellington Street, Strand, London, W.C.2

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- Ease of casting
- Good finish
- Accuracy of shape
- Good machinability
- Resistance to wear
- Rigidity
- Resistance to corrosion

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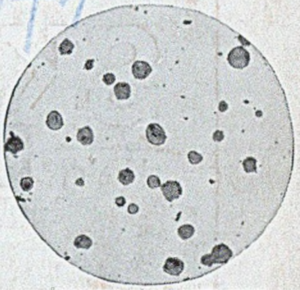
and Ductility too

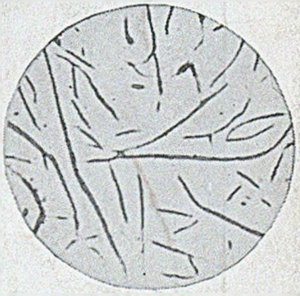


SPHEROIDAL GRAPHITE IRON (ETCHED) x 100

Although cast iron is such a useful material, its lack of strength and its brittleness have hitherto been serious limitations. But now the field of usefulness has been greatly extended by the introduction of a new type of cast iron in which the flake graphite, the weakening constituent, is replaced by spheroidal graphite. In the tensile test, the Spheroidal Graphite Irons have a definite yield point preceded in the stress-strain diagram by the same kind of straight line relationship as is found in steels.

Minimum properties which may be expected from three grades of S.G. iron in commercial production are as follows :—

	Maximum Stress t.s.i.	Yield Point t.s.i.	Elongation per cent.
Pearlitic	37 min.	27 min.	1 min.
Pearlitic/Ferritic	32 min.	24 min.	5 min.
Ferritic	27 min.	20 min.	10 min.



FLAKE GRAPHITE IRON (UNETCHED) x 100

The process is the subject of patents and patent applications and The Mond Nickel Company Limited has granted a number of manufacturing licences. For the names of suppliers of S.G. iron castings, write to :—

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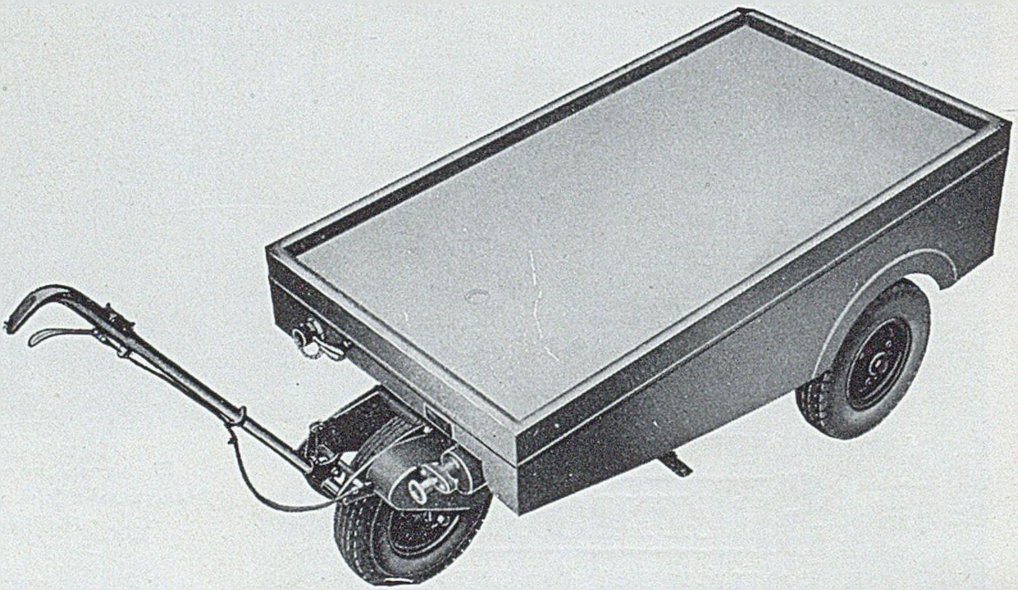

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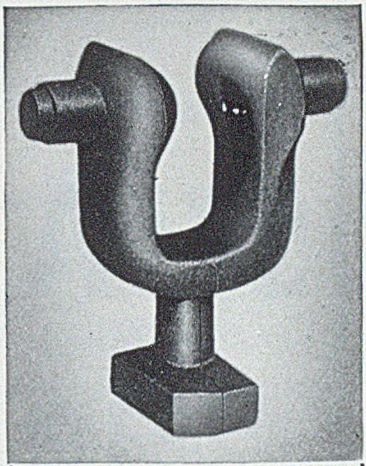

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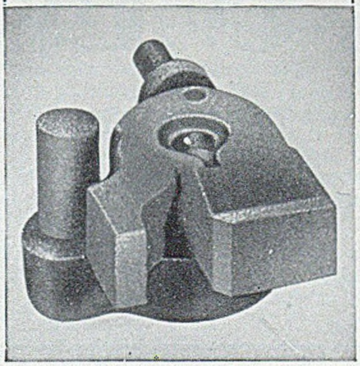
The confidence with which the core maker uses a Glyso-bonded mix is amply justified in the finished core.



Glyso XL Core Powder, a pure film-dried cereal, produces high green strength in the mix and is best used with Permol Core Oil.

Glyso—Exol Core Powders, a range of cereal powders impregnated with core oil in accurate quantities for different classes of core work.

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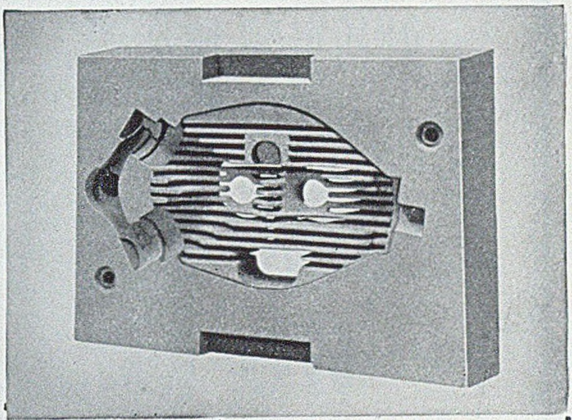

When Glyso is the bond the core makers skill is seen at its best.

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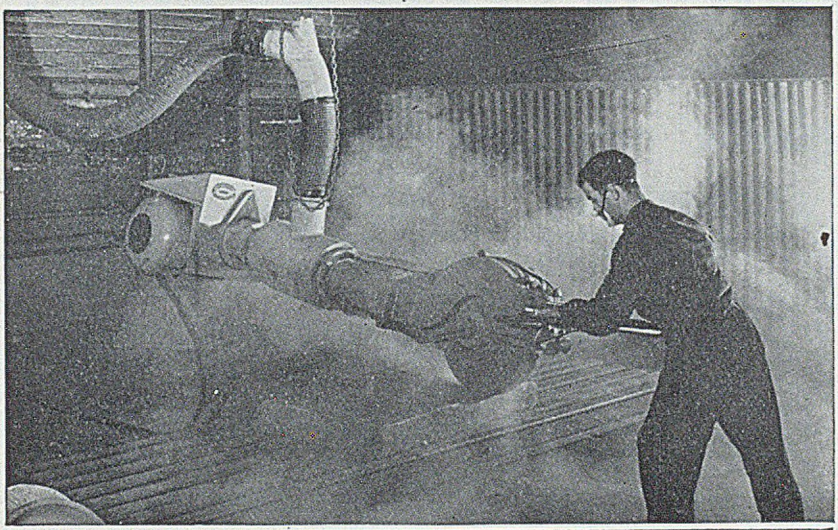
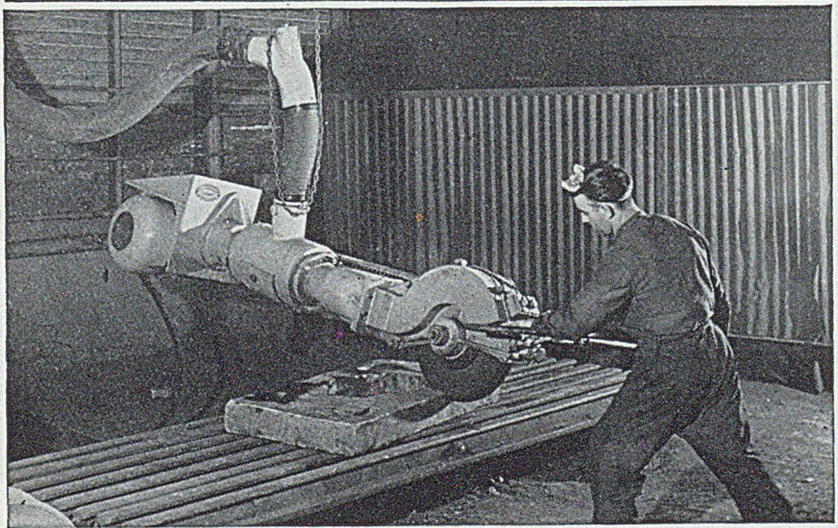
A NEW 20" SWING FRAME GRINDER

which completely solves one of the worst problems in the foundry



GRINDING WOOD WITH EXHAUST **OFF**



GRINDING WOOD WITH EXHAUST **ON**

This Grinder has been designed and built as a result of experiments over four years, and is the fifth model which has been built.

The photographs reproduced above were taken by The English Steel Corporation Ltd., Sheffield and show the machine grinding wood. (This material produces a large volume of smoke which can be photographed). It might be thought that the second photograph is a fake, but this is not so. In actual fact, owing to the direction of the wind, the smoke discharged outside the shop was blown in through the roof ventilator in such volume that a number of people in the shop thought that a fire had been started.

The ESC Swing Grinder is built around an entirely new theory of dust extraction. There is a main duct immediately in front of the wheel and a secondary side duct which draws the fine dust away from the top of the wheel at right angles to the line of rotation.

EXHAUSTIVE TESTS WHICH HAVE BEEN FILMED PROVE THAT THIS MACHINE COMPLETELY SOLVES ONE OF THE WORST PROBLEMS IN THE CAMPAIGN AGAINST PNEUMOCONIOSIS.

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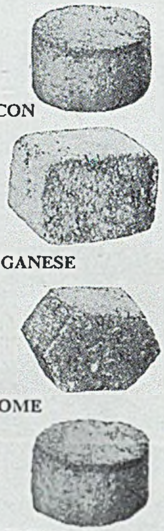
PROVIDE CUPOLA ECONOMY

- Uniform in size
- Regular and consistent recovery obtained
- No mechanical loss of alloy
- Weighing is avoided
- Greater convenience in use
- Allow the use of a higher proportion of scrap in the charge



Type	Manganese		Silicon (Standard)			Silicon (Special)		Zirconium (+ Silicon)		Chrome
Weight of Briquette (lbs.) ...	3	$1\frac{1}{2}$	5	$2\frac{1}{2}$	$1\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{3}{4}$	5	$2\frac{1}{2}$	$1\frac{3}{4}$
Weight of Contained Alloy (lbs.)	2	1	2	1	$\frac{1}{2}$	2	1	2	1	1

BEMCO

GRADED ALLOYS FOR LADLE ADDITION

GREATLY IMPROVE THE STRUCTURES OF CAST IRONS

75/80% FERROSILICON
To reduce chill and improve machinability.

6% ZIRCONIUM FERROSILICON
To improve machinability and increase strength.

S M Z ALLOY
To improve strength and balance section thickness variations.

FOUNDRY GRADE FERROCHROME
To increase chill, refine structure and improve strength.

All Silicon bearing alloys are supplied FREE FROM DUST because fines give uncertain recovery, high oxidation loss and dirty ladles.

GRADINGS :

75/80% Ferrosilicon $\frac{1}{4} \times \frac{1}{16}$: $\frac{1}{4} \times \frac{1}{8}$: 100, 120 & 200 Meshes.
6% Zirconium Ferrosilicon $\frac{1}{4} \times \frac{1}{8}$: $\frac{1}{4} \times \frac{1}{16}$.
SMZ Alloy $\frac{1}{4}$ × 32 Mesh.
Foundry Grade Ferrochrome (65% Cr. - 6/8% Si) 20 Mesh.

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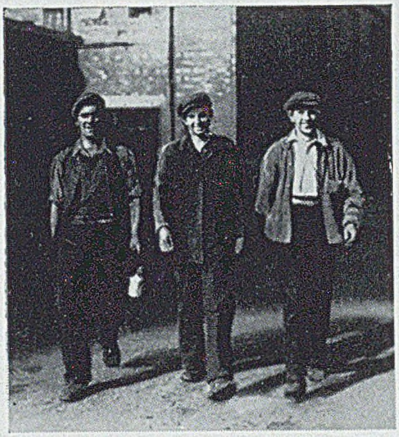
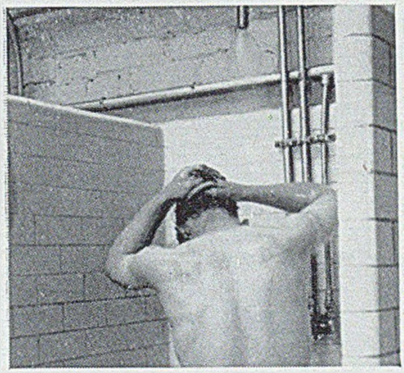


Ablutions and Locker Facilities

The answer to the foundry recruiting problem



The recruitment of young foundry workers is easier in those foundries which are able to offer modern facilities for washing and changing, so that workers when travelling to and from their employment are not subject to invidious comparisons with those in other occupations.

At the same time, the enforcement of the provisions of the recent Regulations regarding heating, ventilation and dust control in foundries gives a further incentive to the better type of worker.

Do consult BRIGHTSIDE on the layout of Ablution Centres and in connection with all problems of heating and dust control. Theirs is essentially a practical approach to the subject as many years of experience in heating, hot water services, ventilation and dust control are coupled with an intimate knowledge of foundry problems acquired in the Company's own foundry interests.

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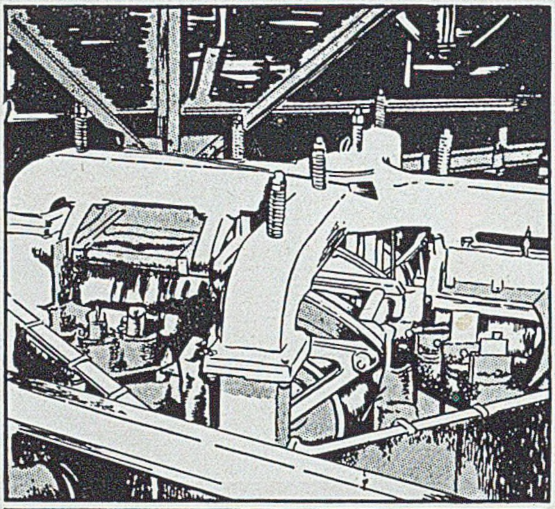

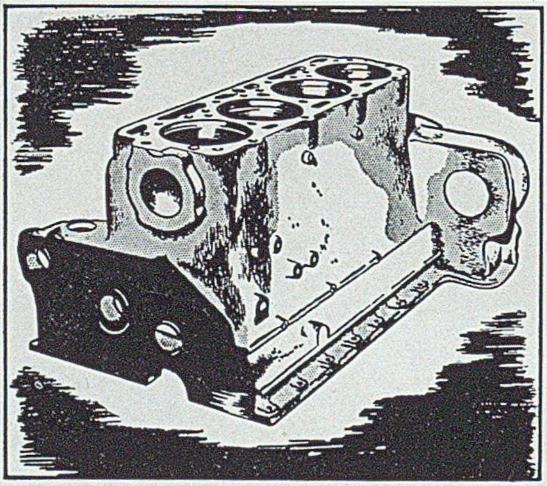

c

Catalac
flame-set spray
for better mouldings
and better castings

Photograph by courtesy of Samuel Osborn & Co. Ltd., Sheffield

So simple to use
Try it!

Saves time — less fettling —dries moulds without stoving
Improves quality — gives cleaner castings by reducing sand-wash and metal penetration.
Stops striking-back and drying out of green sand moulds.
Increases production by reducing scrap.

Apply by low pressure spray and ignite.

Patent Application No. 12404/53

CATALIN LIMITED, WALTHAM ABBEY, ESSEX · TEL.: WALTHAM CROSS 3344

Manufacturers of Core-bonding and Pattern-making resins for the Foundry

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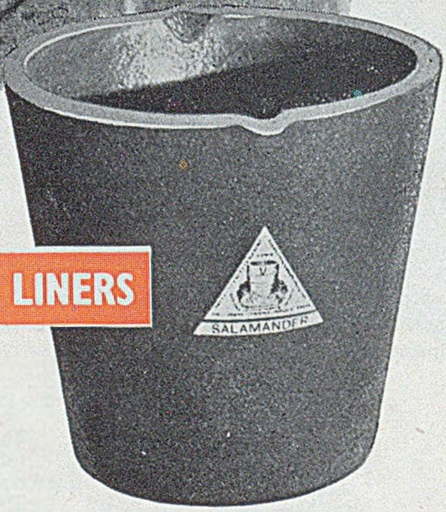
What a bind!

" Every week I have to mess about with dirty clay, daubing the stuff until I feel like an old fashioned potter—and every day I've got to put back the bits that've come unstuck. It's an absolute waste of time."

Have you ever calculated the working hours saved by using pre-fired liners? With hand daubing it takes thirty minutes to refit a ladle, 2 hours to dry out, 15 minutes every day to repair it, with another 10 minutes to dry out ; that's 4½ hours a week—and it only lasts a week ! *117 hours in 6 months spent in maintenance. A Salamander liner lasts as long *without* any maintenance. That is only one ladle—think of the hours saved on *all* your ladles. Added to this, there is no wetting or contamination of the metal, reduced heat loss, easier working conditions and a perfect casting every time. It will pay you to change to Salamander Plumbago Ladle Liners.

★ *Figures based on ladle with 1 cwt iron capacity.*



Salamander PLUMBAGO LADLE LINERS

- No contamination of metal
- Cannot cause porosity in casting
- Reduced heat loss
- Simple, easy fitting
- No slagging
- Maximum working life
- Regular capacity

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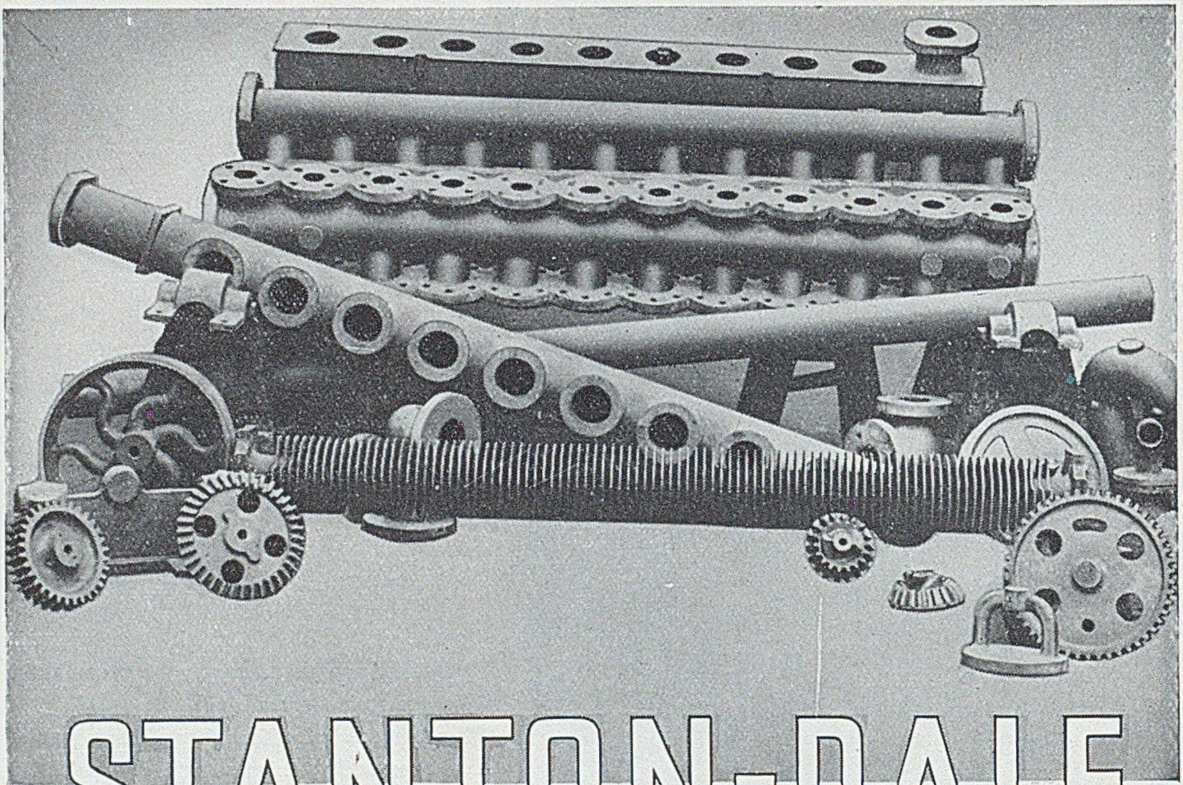

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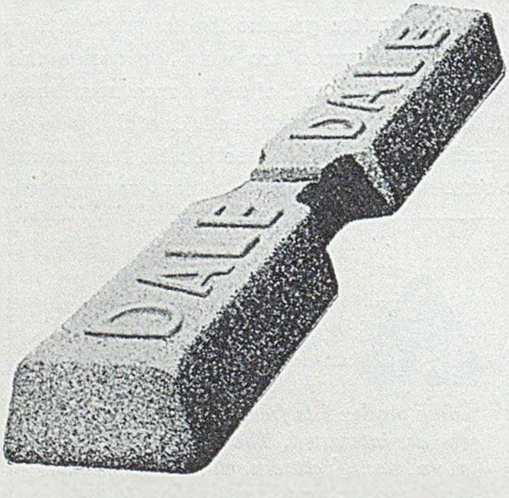

REFINED PIG IRON

Designed to meet the demands of high-quality castings, which are: strength, machine-ability, and resistance to wear.

All these can be secured by using Stanton-Dale Refined Pig Iron in your cupolas.

The above illustration shows a group of castings made from this iron by a well-known economiser maker.

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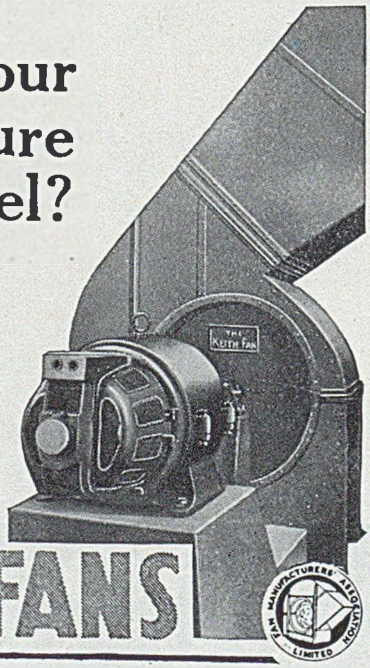

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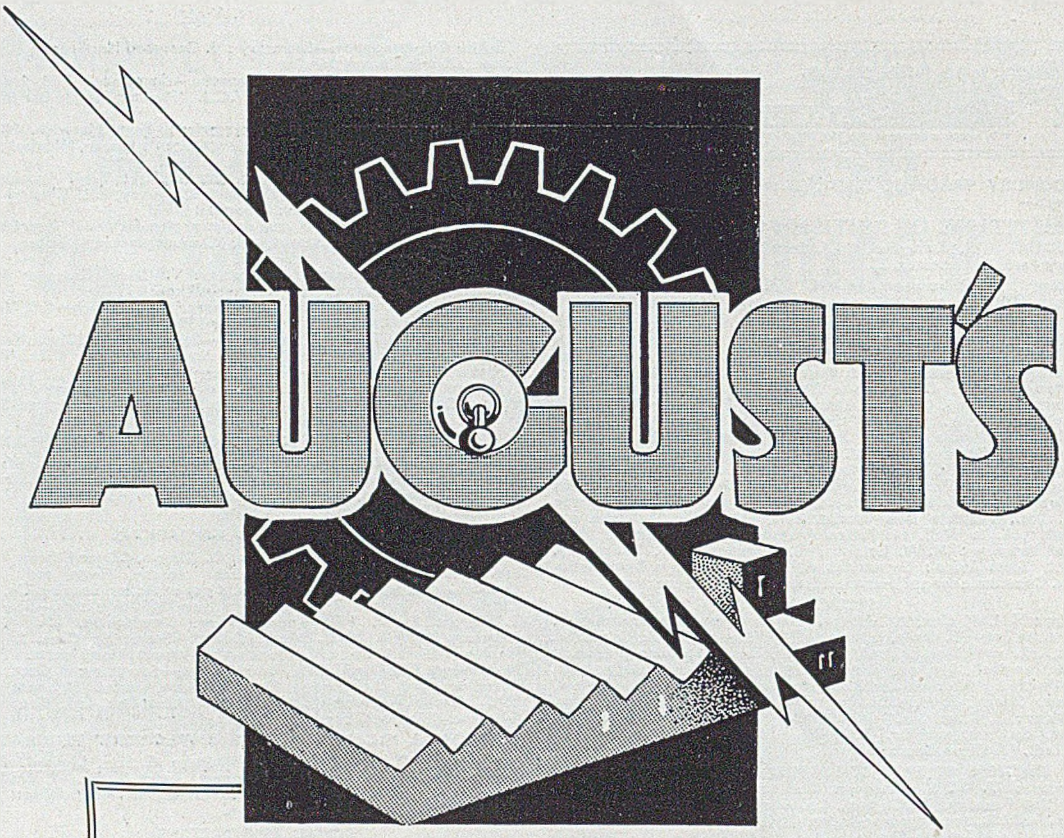
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PRINCIPAL CONTENTS

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Pertinent Questions

When we were young, logic was a subject regularly taught in the public schools. It seems to have fallen out of favour, as experience must have shown that its tenets do not invariably work out in practice. On any logical reasoning, this country and its allies should have lost the war after the disaster at Dunkirk, yet it was not to be so. Maybe it is because when one sets down the answers to a logical approach, they appear to have equal importance. It is then that experience or perhaps intuition comes into play.

These thoughts come into our mind on reading questionnaires prepared by Mr. René Goreaud and published in *La Fonderie Belge* on "Work Organization." The first of these is of general and the second of foundry application. Initially, operation analysis is considered and questions are posed under the headings Why? Where? By whom? and How? Under "Why" is asked: why is it done; why is this operation necessary; and is it not the consequence of an earlier operation badly carried out? For "Where," the following questions are posed: is this the best place; why should it be done here; where could it be done; and could movements be reduced if done elsewhere? Under "By whom," the following appear: who does the operation; is the workman doing it the one who should, and could a less-qualified man do it? Finally, there is "How," and here one is asked: what is the process used; why is the operation carried out in this way; could the work be made easier, and can it be stabilized and waste reduced? The next subject for examination is the man himself. A number of aspects are covered and some operations are classified as to whether use is made of the fingers, the hand, the forearm, the arm and the shoulders together, or progressively diminishing until the fingers alone are used. Here, indeed, is the approach to push-button control.

In the questionnaire specially got out for foundries, quite a few pertinent questions are asked. For instance, it would be interesting to have answers to the rather complicated question referring to methods of working, preparation of moulds, patternmaking, coremaking, melting and fettling, where it is asked whether they are prepared in detail and made known to the operatives [by means of an instruction card] or left to his initiative, skill or choice. Again, it is asked, in connection with hand tools, moulding boxes, patternplates, cores, pneumatic rammers and so forth, as to whether they are in good condition; well adapted to their duties; regularly serviced and tested, and by whom; who is responsible for their distribution to the men; are the grids or the like made by the man himself or by a specialist and can an improvement be made. The last question in the section is: what are the results of deficiencies in tools upon time wastage, fatigue, safety and quality of the users or quality of their output? Machines are dealt with in an equally interesting fashion and, despite our innate mistrust of "latin logic," we cannot help but feel that better foundries would result if the executives asked themselves and gave reasoned answers to such questions as have been posed.

Conference Paper Author

Mr. B. Gale, Author of the I.B.F. Conference Paper "Foundry Developments in the Textile Industry," the first section of which is printed in this issue, commenced his career in the general jobbing foundry of Edward Stevenson, Limited, Nottingham. Here he worked for 20 years, rising to the position of assistant foundry manager. In 1933, he joined Qualcast, Limited, Derby, as technical representative, and was successively assistant foundry manager and foundry manager of the grey-iron foundry of that company. In 1940, he entered the service of Rolls Royce, Limited, and was assistant to Mr. J. Vickers in the development of the mechanized foundry at Hillington, Glasgow, for the production of the Merlin engine. In 1942, he took control of the malleable and grey-iron foundries of Simplex Electric Company, Limited, Oldbury, and at the end of the war he was responsible for the building of their new mechanized foundry and coreshop for the production of electric-cooker castings. He joined Textile Machinery Makers, Limited, in 1949 as foundry manager to Platt Bros. & Company, Limited, Oldham, and was later transferred to the larger foundries of the group as foundry manager of Howard & Bullough, Limited, Accrington, the position he now holds.

Mr. Gale joined the Institute of British Foundrymen in 1925, and was for a number of years secretary of the East Midlands branch, being vice-president when he left the branch for Scotland. Whilst in the Birmingham area, he was a member of the council of the Birmingham branch, and represented that branch on the General Council. He is now a member of the council of the Lancashire branch and the Burnley section. Mr. Gale has lectured before a number of branches and was awarded the Diploma of the Institute for a Paper to the Wales and Monmouth branch in 1933. He is a member of the executive council of the Manchester and District Ironfounders Employers' Association.

Developments at East Kilbride

Construction work on a new factory for the firm of Hayward Tyler, Limited, whose parent works are in Luton, and which will give employment to at least 250 workers, has begun at Nerston, East Kilbride. Reporting this recently, Sir Patrick Dollan, chairman of the new town Development Corporation, says this new light engineering industry will be engaged in the production of specialist equipment. The firm are closing down their plant at Portobello, near Edinburgh. Machinery required to equip the new plant and a number of employees will be transferred from Portobello next year.

There are now almost 3,000 workers on the payroll of the manufacturing and industrial concerns in the new town, while a further 1,500 find employment on housing, road and other public contracts. Sir Patrick also reports that Rolls-Royce, Limited, are planning to increase their skilled personnel by a further 1,000 before the end of this year.

Mitchell Cotts & Company, Limited—Mr. Alan S. Roger has been appointed a director.

Birmingham College of Technology

The Department of Industrial Administration of the Birmingham College of Technology has issued a progress report to mark the completion of its first six years. In that period, it has developed to the largest centre of management studies in Britain and has given courses to almost 1,000 people from Midland industry. Its full-time staff are all drawn from industry, and there has been enthusiastic support throughout from industrialists. The broad aim of the department is to indicate to prospective managers the varied and various techniques they must learn to equip them for managerial responsibility. These include costing, production control, works study and measurement, marketing and sales, industrial relations and human relations. No claim of any kind is made that the department can produce managers, being concerned only with the teaching of management techniques.

Towards the end of each course, students bring their knowledge into action to solve typical problems, culled from industry. These are recorded on gramophone records so that the student gets the facts of a problem orally as he would in practice. In addition to its main activity of giving courses in industrial administration, the department runs a modified form of the same course for supervisors, and specialist courses for personnel officers and work study personnel. There are also part-time courses for workpeople's representatives and also for directors and executives. The Head of the Department is Mr. David M. Bramley, himself a former production manager.

Glasgow Foundry Blaze

Workers scrambled to safety when a crucible of molten metal burst in the furnace section of J. R. MacKellar, Limited, Dennistoun Works, of Glasgow, on August 11. The heat set alight the oil feed of a furnace and the blaze spread to the rafters and roof. Men running to safety pulled cylinders of highly-inflammable gas and oxygen out of the building. Flaming *dêbris* crashed to the ground as firemen tackled the blazing roof from outside and inside the building. The firm, which specializes in non-ferrous castings, employs about 30 men at the works. The furnace section was extensively damaged by fire, but it is not expected that production will be greatly affected.

Institute of British Foundrymen Eighth Annual Golf Meeting

Woodhall Spa, September 26 and 27, 1953

With still a fortnight to go before entries close, we are advised by the Hon. Secretary of the I.B.F. Golfing Society, Mr. F. Arnold Wilson,, William Jacks & Company, Limited, Winchester House, Old Broad Street, London, E.C.2, that he has already received 35 entries for the men's event and 10 for the ladies' competition, and the total party now numbers 63.

This will serve as a reminder to those who have not yet sent in their entries that time is getting short. There are still a few rooms left at the Golf Hotel.

"Compressed Air can be Dangerous" is the title of a little pamphlet published by the Royal Society for the Prevention of Accidents. It is intended as a "hand-out" for employees, and it describes very simply and briefly when physical damage can be caused by skylarking with compressed air. It also gives a timely warning against the common practice of "dusting oneself down."

"Foundry" Development in the Textile Industry*

By B. *Gale*

The word "textiles" covers one of the largest groups of basic industrial activity in Great Britain, and in particular, in the county of Lancashire. Textiles can be roughly divided into two classes (a) *The manufacture of yarn from the raw materials of cotton and wool, and in latter years, synthetic fibres such as Nylon, Rayon, etc., and* (b) *the weaving industry for the manufacture of materials for multiple purposes from the yarns produced by the former class. This Paper deals with the foundry production of castings for the machinery employed to manufacture the yarns from the raw materials under class* (a) *and covers types of machines; foundry methods of production past and present and metallurgical aspects. It is of singular interest that here there are the combined efforts of two major basic industries, iron and textiles.*

The group of companies represented by the Author, Textile Machinery Makers, Limited, covers the manufacture of every machine necessary for the production of yarns of every type from the "gin" which gathers the cotton from the cotton fields, to the spinning frame which produces the yarn, or the reel of cotton used in the household. The subsidiary companies, with names of world-wide fame, such as Platts, Howard and Bullough, Dobson and Barlow, etc., have all longstanding business in textile machinery of well over 100 years, and in the past all operated independently. The group was formed in the early 1930's and through co-ordinated management, a degree of specialization has taken place, different companies now specializing on certain classes of machinery instead of each making the full range. The Group now operates twelve foundries with a combined output of some 46,000 tons of light castings per year, representing millions of castings from thousands of different patterns.

* Presented at the Fiftieth Annual Meeting of the Institute of British Foundrymen. The Author is foundry manager of the Howard & Bullough, Limited, foundries of Textile Machinery Makers, Limited.

Types of Machinery

It is probably of interest at this stage, to give a brief outline of the machinery necessary for this complicated process of manufacturing yarns, with some idea of their development over the past 150 years. The textile trade generally processes alone or in combination:—(*a*) animal fibres such as wool; (*b*) vegetable fibres such as cotton and (*c*) man-made fibres such as nylon. The majority of finished textile products are constructed by first arranging the fibres in threads, which are later formed into fabrics by weaving, knitting, etc.

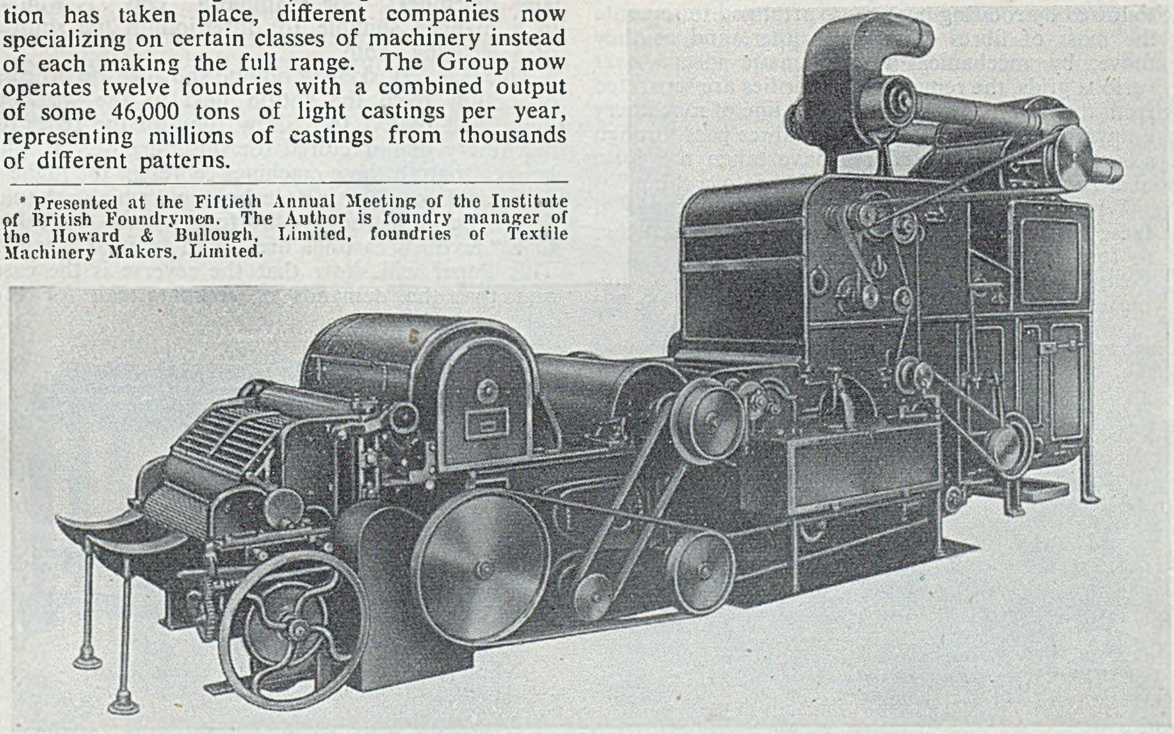

FIG. 1.—*Scutcher Machine which occupies Final Place in the Processing of the Raw Cotton in the "Blowing" Room.*

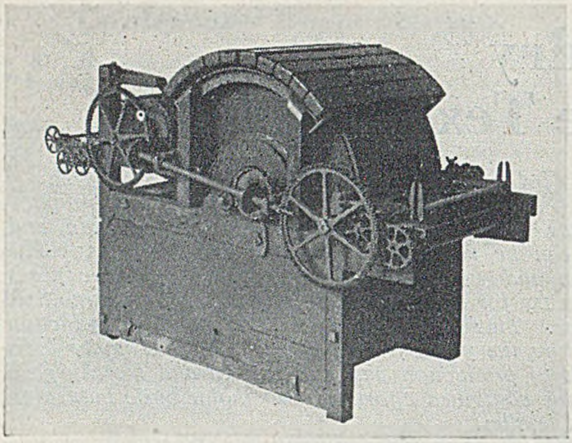

FIG. 2.—*Original Carding Engine made and designed by Arkwright in* 1790, *and now on Exhibition at Platt Bros & Company, Limited, Oldham.*

A selection of machines used in the processing of cotton would be as follows:—The cotton pod is hand- or machine-picked, and passed through a "gin." This machine separates the fibres from the seed and removes some of the sand, leaf, etc., and the cotton is then baled for transport. On arrival at the mill, the bales are passed through a series of machines for opening the bales, and the material passes through several plain and spiked laths, followed by rotating beaters, so arranged to separate the mass of fibres from each other, and as they move, by mechanical or pneumatic means over various grids, the remaining impurities are separated from the fibre. At the end of this line of machinery known as the blowing room, the fibres pass through a scutcher where the fibres have taken the form of a rough sheet and this is rolled into a "lap."

When higher qualities are required, several of these laps may be fed together into another scutcher to form another lap of similar dimensions, but of greater regularity. The lap is then fed into a carding engine. Here the fibres are torn from the lap sheet by wires on a drum known as the "taker-in," revolving at high speed. The few remaining impurities are removed through grids.

A second drum, known as the "cylinder" takes the fibres from the first drum, which in turn are removed by a third drum known as the "doffer." During their passage through this machine, the fibres are "carded," and as they are removed from the doffer, are drawn into a rope about 1½ in. dia. known as a "sliver," and coiled into a cylindrical container. Several slivers are then fed into a machine known as a draw frame and are drawn together into a sliver of the original thickness. A number of these slivers are next fed into a flyer frame in which they are drawn into a coarse thread through a succession of rollers with progressively increasing peripheral speeds, and wound on to a bobbin. The winding arrangement also twists the fibres to give strength to the thread. The "doubling" of several threads to reduce irregularity; the drawing-out of thread to several times its own length to reduce its thickness, and the addition of "twist" are the features of several successive types of the flyer-frame known as "slubbers" "intermediates" and "rovers."

The bobbins of thread then go to the finer spinning frames such as the "mule" and the "ring frame." The later machines are arranged to wind the thread onto a spindle or a paper tube, in place of the bobbin on earlier machines. These different "packages" are more suitable means of handling the thread for transport to and treatment on the later machines. For example a "cop" is wound in a manner suitable for insertion in the shuttle of a weaving loom.

This is a very sketchy outline showing the process of cotton from the cotton field to the weaving loom, and Figs. 1 to 8 show some of the types of machinery manufactured for this purpose. It will be seen that all these machines represent the highest degree of engineering technique, which should dispel the idea amongst the foundrymen generally, that "textile" castings are of an inferior quality. This Paper will show that the reverse is the case and that the demands of spinning call for the

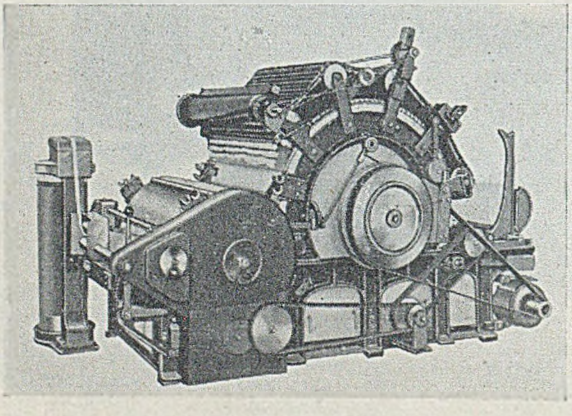

FIG. 3.—*Modern Carding Engine for which the Components are principally Iron Castings.*

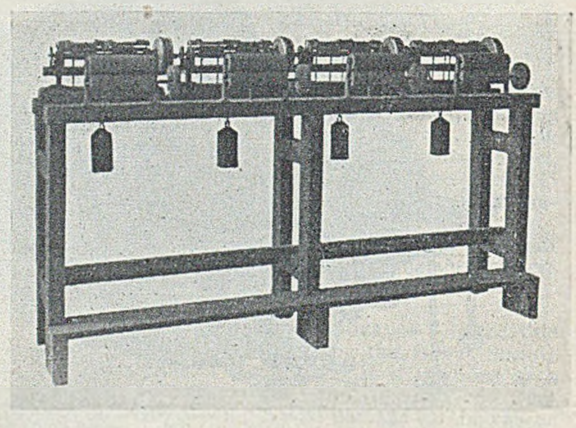

FIG. 4.—*Draw-frame Machine made in the 19th Century.*

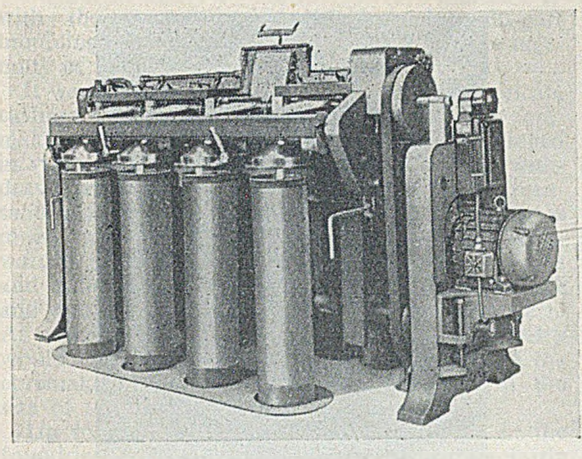

FIG. 5.—*Modern Draw-frame Machine (compare with Fig. 4).*

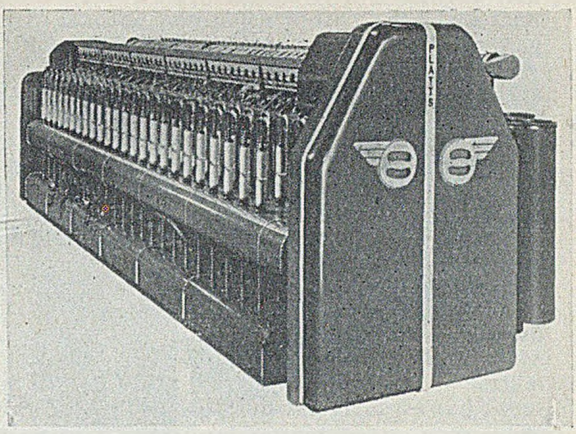

FIG. 6.—*Flyer-frame Machine which produces a Coarse Twisted Thread from a Number of "Slivers."*

highest skill of fine-tolerance engineering from the pattern to the finished machine, so as to run threads at very high speeds without breakage. For instance, a typical spinning frame may have 400 spindles, each revolving at 12,000 r.p.m. with complete absence of vibration; it is in this latter respect that cast iron, as the major material used in manufacture, is particularly valuable due to its inherent damping capacity.

Foundry Practice

The manufacture of castings for the textile industry covers a very wide field. One cannot refer to any type of machine and call it a standard. The many types of yarn manufactured, coupled with the individual demands of the mill technicians, creates numerous variables of the same type of machine, and, as such, the machines cannot be mass-produced, as in many other types of engineering practice. When all technical details for a mill or machine are settled and pattern equipment made, the thousands of castings required are divided into various classes of foundry production. If a ring spinning frame is taken as an example—and taken at random, the Author has viewed a part's list of a frame with 296 spindles—one finds that this particular machine covers some 300 patterns with quantities varying from 1 off per frame to 296 off per frame.

An order may be for only one frame or for a

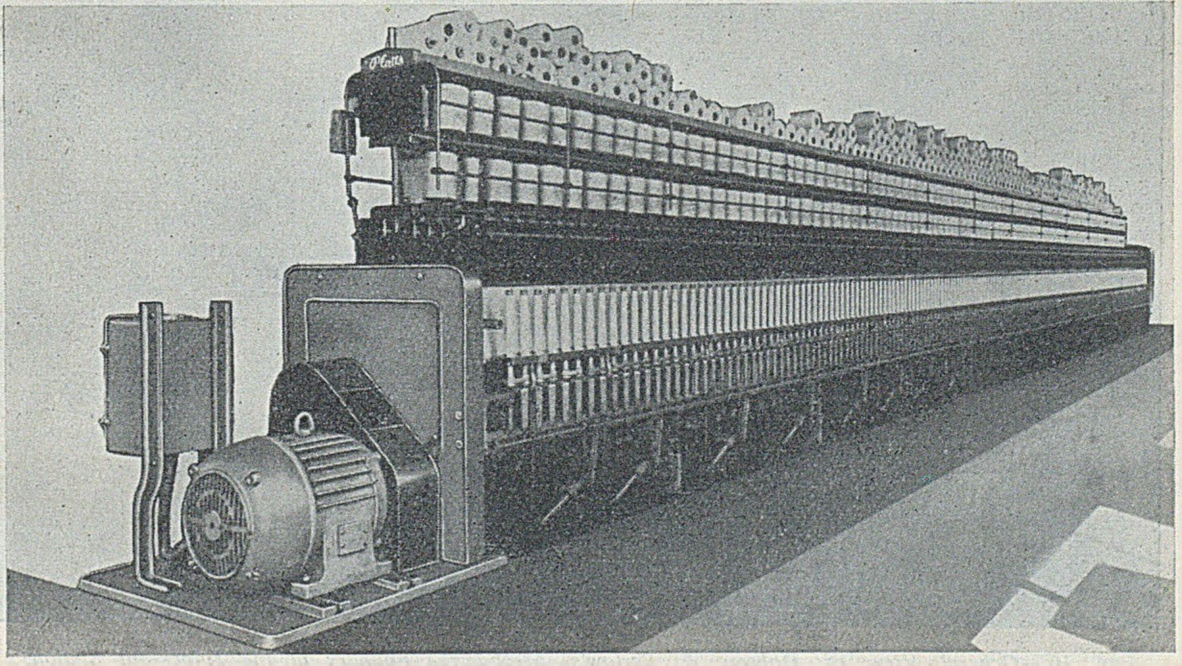

FIG. 7.—*Ring Spinning Frame, which winds the Thread on to a Spindle or Paper Tube.*

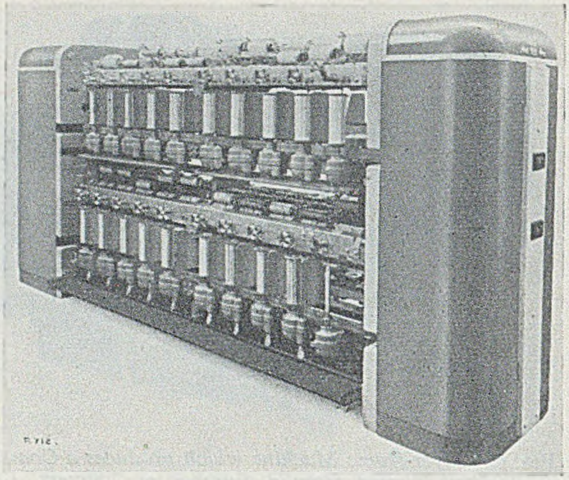

FIG. 8.—*Uptwister Machine for Preparing Synthetic Fibres into a Form suitable for the Looms.*

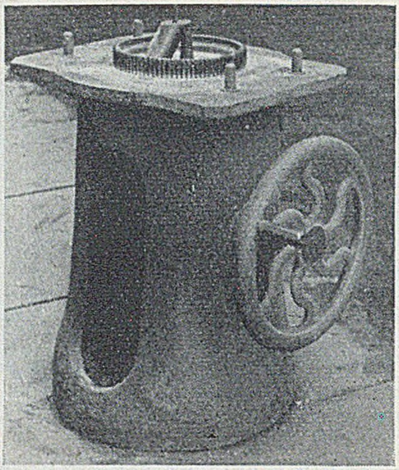

FIG. 9.—*Old Stripping-plate Machine as used for Producing Gear-wheel Moulds.*

larger number of frames. Certain parts are special to the order, others may repeat on different orders, whilst some are common on all frames. The production control staff, therefore, are always faced with small lots, medium lots, and large-quantity production, and so have to plan their work through the foundries based on different methods of production, from loose-pattern moulding to fully-mechanized plants. This leads to a demand for considerable versatility on the part of the foundry staff and has led over the years to a considerable degree of plate moulding. It has been said, but the Author makes no claim for its authenticity, that it was a foundry foreman at Platts many years ago who first made plate moulding a feature of British foundry practice. Certainly, the Author has seen and worked during the past few years, some very remarkable examples of plate moulding, when producing spare parts for machines built over 70 years ago, and some of these old plate patterns,

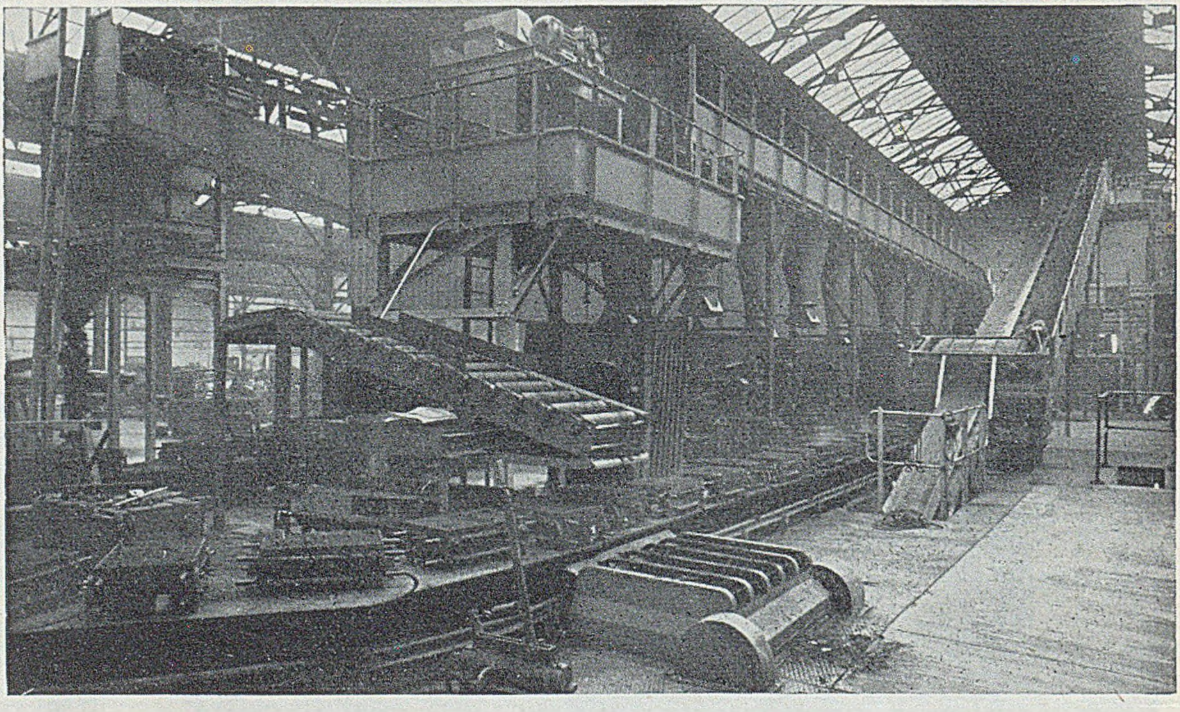

FIG. 10.—*General View of Dobson & Barlow's Mechanized Foundry at the Knock-out Station. Under-frame, Squeeze-type Moulding Machines are used.*

with their specially-designed hinged multi-part moulding boxes, speak very highly of the ingenuity of those old foundry craftsmen.

It was very noticeable that in those days intricate castings were moulded with the minimum of coremaking by making special moulding boxes, hinged in various directions to enable patterns to be withdrawn and castings produced wholly from greensand moulds. Even to-day, when coremaking is much more widely used, to dispense with awkwardly shaped joints, etc., it is still the practice and policy to avoid coremaking wherever possible and make the job in green-sand from the pattern. As a result, the stranger visiting a textile foundry would be surprised at the very small size of the coremaking department, in comparison with the size of the foundry in general.

Up to the 1930's the general production in the foundries consisted of loose-pattern work, a fairly high percentage of the operators being skilled moulders. Plate moulding on floor and bench and numerous types of moulding machines of the pattern-draw or stripping-plate types were in vogue, most of which were designed and made in the foundries to suit the particular jobs. To this day, jobbing orders for spare parts of these old machines are still produced on the old home-made moulding machines, which have been in operation 70 years or more. It is the Author's opinion that some of these methods can still hold their own against modern equipment for small quantities.

Fig. 9 shows one of these old stripping-plate machines for moulding gear-wheel castings. The pattern is made very much wider on the face than the normal castings required and so, by setting the depth of pattern projecting through the stripping plate to a gauge, wheels of any varying face width up to the maximum allowed for can be produced from the same set-up. Modern machine design calls for machine-cut gears and castings are now made as gear blanks only. The old cast gears are, however, still produced on these machines for spare-part orders.

During the 1920's and 1930's much of the larger quantity production was moulded by orthodox hand and power moulding-machine methods, whilst plate moulding was still largely in evidence as well as hand pattern work, on a reduced scale. The war of 1939-1945 caused a cessation of textile-machine manufacture, and the factories and foundries were occupied on various war projects. The management were fully alive to the demands that would be made upon them when war ceased, and planned foundry mechanization schemes in readiness for the return to normal trading. As soon as war ceased in 1945, the three major foundries embarked upon installation of various types of mechanized plant, a policy which has been continuously followed, and which is always occupying the attention of the directorate. Indeed, this policy has been so forcefully applied that the present day shows over 50 per cent. of the total tonnage being produced by mechanized means, and future plans are envisaged to bring this figure up to 80 per cent.

The general run of small types of castings is now

FIG. 11.—*View of Platt Bros.' Mechanized Moulding Plant showing Ten Orthodox Jolt-squeeze Pin-lift Moulding Machines, Two Pairs of which have since been replaced by "Automold" arrangements.*

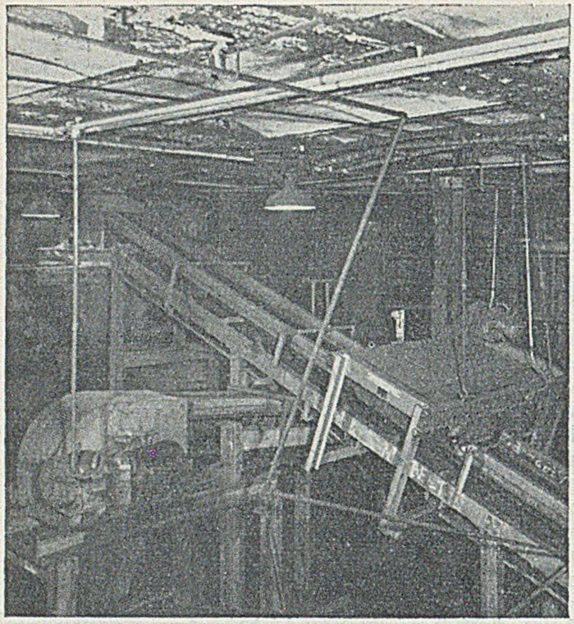

FIG. 12.—*Sand-preparation System for the Plant shown in Fig. 11.*

produced by the usual mechanized foundry plants, and whilst each of the foundries is generally occupied on castings for its own particular Company's product, the management have had fullest investigations into standardization of moulding plates, boxes, etc., to enable easy transfer of work from any one foundry to another to meet demands. Fig. 10, shows a general view of the Dobson & Barlow mechanized plant, utilizing the under-frame squeeze type of machine. This plant operates on the continuous sand milling system, the sand being the fully synthetic variety comprising a graded silica sand mixture with colloidal clay additions.

Platt Bros.' Foundry

Fig. 11 shows a general view of the Platt Bros.' foundry plant, operating with a line of ten jolt-squeeze pin-lift moulding machines. A later development on this plant has been to replace two pairs of the orthodox machines by "Automold" machines, comprising a synchronized jolt-squeeze and pattern-lift arrangement on each pair of machines. This plant works on a synthetic-sand system, using a batch mill type of sand supply. Fig. 12 depicts a general view of this sand system, which supplies sand to this plant in addition to supplying a semi-mechanized plant, and a specialized sand-slinging plant. The obvious advantage of batch milling in this case is that it enables the plant to supply sand mixtures suitable for the different types of moulding practice.

Fig. 13 shows a very interesting feature of the sand system at Platt Bros.' foundry. Four small hoppers are arranged with a disc-plate feed, two on either side of the main sand conveyor belt from the storage hoppers to the measuring hopper, which is situated over the batch sand mills. These four small hoppers are filled with silica sand, colloidal clay, coal-dust, etc., and by a time-switch arrangement fixed on the sand-mill platform, the operator can automatically bring into operation any combination of the "additions" hoppers to add specific amounts of the various additions to the stream of "black" sand travelling up the belt. This has

FIG. 13.—*Arrangement of Four "Addition" Hoppers over Sand Conveyor Belt leading to the Measuring Hopper supplying the Batch-type Sand Mills.*

FIG. 14.—*Monorail Pouring Station at the Platt Bros.' Plant; each Pallet takes two Moulds. The Conveyor is operated by Pneumatic Rams.*

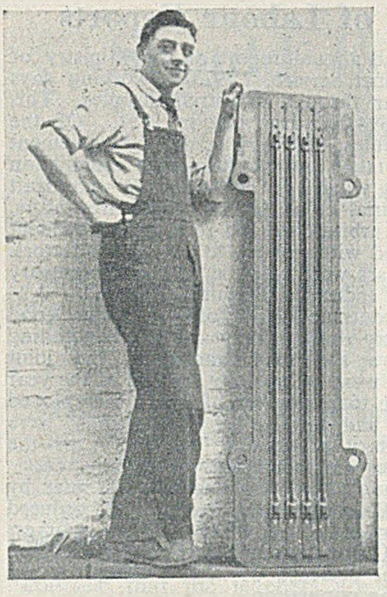

FIG. 15.—*Plate Pattern used for Carding-machine "Flats."*

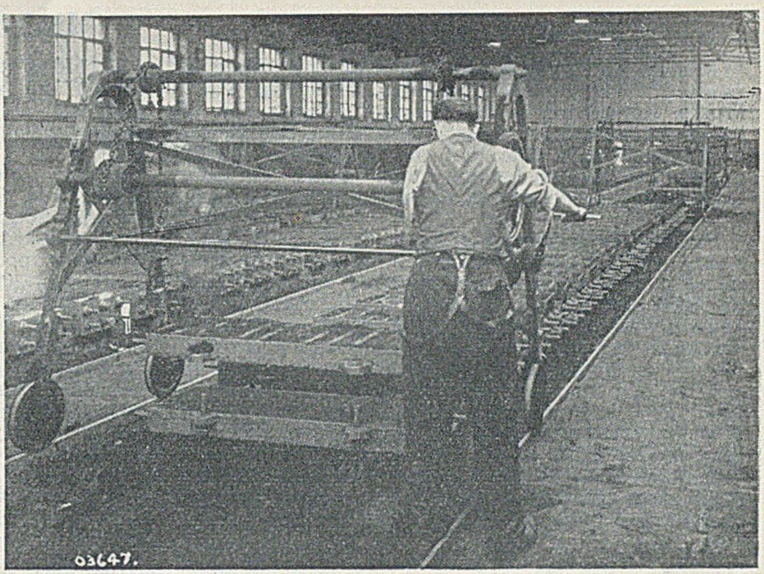

FIG. 16.—*Rail-line System previously adopted for producing Carding-machine "Flats."*

several excellent features. The additions are meticulously controlled and errors due to the human element are eliminated; the controlled trickle of clay, coal-dust, etc., into the stream of black sand ensures very even distribution through the bulk batch of sand and facilitates mixing, as compared with the method of adding such materials *en bloc* into the mill. This hopper-feed method contributes considerably to the general cleanliness of the plant and prevents dust at the sand-mill station.

Fig. 14 shows the monorail pouring station on the pallet conveyor. It will be noted that each pallet contains two moulds. The conveyor varies from the usual continuously moving design in that it is operated by pneumatic rams giving intermittent movement of the conveyor (on each stroke of the ram). This is so designed that each movement is 5 ft.—the length of a pallet—and is so synchronized that a full pallet comes to rest opposite the plunger push-off at the knock-out. Actual removal of the moulds from pallet to knock-out grid, therefore, takes place whilst the conveyor is stationary during the return stroke of the rams driving the mould conveyor. *(To be continued.)*

Titanium

The Ministry of Materials announces that it has recently concluded a contract with Imperial Chemical Industries, Limited, under which the Company will at its own expense erect capacity to produce 1,500 tons of sponge titanium a year. The Company will also instal capacity for converting this metal to ingot form, and it expects production to begin in two years' time. The Ministry has undertaken to buy directly up to three-quarters of the Company's output of sponge titanium over the first four years of production if the metal is not otherwise sold in various forms for use by Government contractors, and the Ministry has an option on the full output if needed for defence purposes. The price of the metal will be equivalent to the world price current at the time of purchase. Apart from this project, the Ministry understands that I.C.I. already has in course of erection pilot plants which will begin to produce at the rate of 150 tons per annum early in 1954.

Mr. J. Steele, a vice-president of the South African branch of the Institute of British Foundrymen, sailed last week from Southampton. He and his wife had the unique experience of camping on a bombed site almost within the shadow of Westminster Abbey.

C.D. Units in Industry

The latest development in the Civil Defence programme is the issue of a Home Office bulletin to give effect to the Home Secretary's decision last December that C.D. units formed for the protection of business premises should constitute an Industrial Civil Defence Service independent of units organized by local defence councils within the Civil Defence Corps. The bulletin emphasizes that to be effective industrial units must work closely with civil defence controllers of the corps and must be integrated with units organized by the local government authority in each area. For instance, the place which each industrial unit would occupy in the local authority's operational plans, and the boundaries of industrial groups, should be discussed between representatives of the Civil Defence Corps authorities and those of industry and commerce in each local authority area.

Where managements decide to provide uniforms for members of their units, says the bulletin, it should take the form of navy-blue battle-dress blouse, trousers (or skirt), and beret, carrying the service badge, which should embody a representation of the Crown and the name or emblem of the undertaking. For tax purposes, expenditure on uniforms and badges could be classed generally as revenue.

New Catalogues

Mixing Valves and Sprays. Whilst a catalogue received from Gummers, Limited, Effingham Valve Works, Rotherham, is devoted to the application of valves and sprays for hospital and school application, readers will appreciate that the fittings are equally applicable to foundry bathing establishments. The catalogue is well produced and adequately illustrated.

Foundry Craft Moulding Apprenticeship. W. & T. Avery, Limited, Soho Foundry, Birmingham, 40, have issued a brochure with the object of informing boys and their parents of the great and in some cases unusual benefits given by this firm to the moulders' apprentices. Unlike most publications of this character, it is solely devoted to foundry craft. There has been no need to gild the lily by clever salesmanship as the scheme is such that it is bound to appeal to the practical-minded who appreciate amenities and incentives. The only snag to our mind is announcing of a foundry near Leeds, and then referring to a sports ground at Sandon Road in the Birmingham area, but maybe this brochure is only meant for boys in the Midland area.

Safety Clothing. Plysu Products, Limited, of Woburn Sands, Bletchley, Bucks, has issued a 12-page brochure which describes and illustrates a wide range of safety clothing made from a P.V.C. plastic. This material is unaffected by water, acids, alkalis, and many chemicals. As the material cannot be made up by sewing, the seams are welded, using H.-F. current. Buttons are similarly attached and no metal whatsoever is used. According to the nature of the soiling some suits are pressurized. For cleaning, a hose pipe or tepid soapy water is used. This interesting catalogue is available to readers on request.

Refractories. This industry seems to get more complicated every year. There was a time when silica, firebricks, chrome and magnesite completed the entire range. In a catalogue received from General Refractories, Limited, Genefax House, Sheffield, 10, details are given of refractories made from obsidianite, which are used for lining pickling tanks, acid concentrators, and other acid-resisting applications. Then a second catalogue covers a line of high alumina bricks made to withstand severe chemical attack and abrasion in cement, lime, chemical and metallurgical industries. The two items listed are made by Charles Davidson, of Chester—a branch of General Refractories.

They have also issued a 14-page well-illustrated booklet dealing with Lowood power-pressed silica refractories. Old-timers, like the reviewer, much appreciate dimensional accuracy and the picture of the electric furnace carrying holes for the electrodes made from five sections brought back memories of personal attempts to carve out the holes by hand cutting. Even with this crude method, better results were obtained than when using an oversize, and probably under-fired, hollow blank. The booklet describes the careful methods used in manufacture and details the chemical and physical data of the various shapes and sizes made, including suspended arches. These very attractive booklets are available to readers on writing to Genefax House.

DURING THE WORKS' ANNUAL HOLIDAYS production of Armstrong Whitworth & Company (Pneumatic Tools), Limited, was transferred from Gateshead to the West Chirton trading estate, North Shields, to meet the need for increased accommodation. The works employs some 300 people.

Ministry of Labour Reports

According to the annual report of the Ministry of Labour and National Service, 1,792,000 working days were lost last year through industrial disputes. This compares with 1,694,000 days lost in 1951. Of the total of 1,714 disputes, 320 were settled by agreement following actions taken by the Ministry's conciliation officers, and 130 by voluntary arbitration; 71 were dealt with in the industrial court, 25 by single arbitrators, four by boards of arbitration, and four by independent chairmen appointed with powers to act as arbitrators. More than 200 cases were referred to the compulsory arbitration of the Industrial Disputes Tribunal.

The Ministry continued its efforts to foster good relations in industry during the year. Six negotiating arrangements of a similar character to the joint industrial councils were set up. By the end of the year 80 per cent. of the total number of workers employed in the industries and services of the country were covered by voluntary negotiating machinery for the regulation of wages and conditions of employment.

The total working population declined last year by 22,000 to 23,300,000, partly as a result of reduced activity in consumer goods trades. Male workers increased by 13,000, but the number of women declined by 35,000, the net decrease of 22,000 being 0.1 per cent of the working population.

There were 858 industrial stoppages involving 142,300 workers in the loss of 647,000 working days in the first six months of the year, compared with 908 stoppages involving 214,500 workers in the loss of 897,000 working days in the first half of 1952. Stoppages in the engineering industry fell from a loss of 162,000 working days in the first six months of last year to the loss of 33,000.

British Standards Institution

In the Annual Report of the Work of the British Standards Institution for the year 1952-53 it is stated that there has been further emphasis during the year on standards work in relation to our export trade. Increased standards activity overseas makes it essential that the B.S.I. should, through participation in the International Standards Organization, the International Electrotechnical Commission, and by other means, do everything practicable to ensure that standards set up in other countries do not constitute a barrier to international trade as formidable as a new tariff or a policy of import restrictions. The B.S.I.'s work has been directed to this objective as well as to the more general one of expanding international trade by promoting the interchangeability of goods, equipment and machinery and the speeding up of transport through standard handling apparatus and the like. These aspects of the Institution's work are now of major importance. One special aspect of international work that has been brought well towards fruition during the year is that of American-British-Canadian unification of fundamental engineering standards.

Under the heading "General Statistics", the Report states that there are now 7,836 subscribing members. During the year 162 new committees were set up, 21 existing committees reconstituted, 129 committees disbanded and the representation of many organizations on B.S.I. committees reviewed. The number of standing committees is 2,318 and committee membership is 13,799.

MR. E. W. STOKES, of Stokes & Sons, Pty., Limited, brassfounders, of Melbourne, Australia, is at present visiting this country.

Should Foundry Science be taught at a University?*

By A. Ivanoff, Ph.D.(Eng), M.Sc.(Eng).

[*Abstract*]

Libraries are full of books on education, and journals are full of papers and presidential addresses dealing with the same subject. Anyone setting out to add to this flood of words had better say something different. That then is the excuse for dealing with the question of scientific education for the foundryman. In fact, it is proposed to talk of foundry science at a university.

Many reading the title of the paper will comment: "But surely foundry work *is* taught at several universities: witness the City and Guilds course!" That is true enough. What is in mind is not that foundry science should be taught at a university, but that the subjects taught, and the standard reached are those expected from degree courses; that the teachers are thoughtful people, themselves of university standard. A university is a place where the fundamentals of science are taught, and where one is taught to think. That, it is submitted, is the difference between what is achieved at a local technical school and a university worthy of that name. The present foundry courses are in the main designed to teach artisans, and this they do very well. When science is taught as a part of such a course, it is of an elementary standard which is best described as "workshop calculations."

The only other sphere in which one meets scientific subjects of interest to foundrymen is metallurgy. Does that supply the need? Well, there are two answers to this query: first of all, reference is being made to training the foundryman, not the metallurgist, who is, in effect, an adviser to the foundry manager. Secondly, metallurgy is now a science of considerable breadth, and in a course of metallurgy one cannot expect to get much room for foundry subjects. In fact, a course of metallurgy with a big accent on foundrywork might even get a poor name among metallurgists. They would probably say: "Yes, he has a degree in metallurgy, but it was one of those foundry metallurgy courses, you know."

Matter for a Course

One may well ask at this point: "If a foundry course is suggested, will there be enough matter from which to form such a course?" The problem will be not so much to find the subjects, as to find room for all that should be taught. Let a survey of some of the subjects be made. The Author is fond of saying that there are four basic subjects which are fundamental to all technology. These subjects are: mathematics, flow of heat, flow of fluids, and strength of materials. It is not surprising that the same four subjects underlie foundry science too. It is unfortunate that these subjects are seldom taught well enough; and all technologists who have had the misfortune to be taught these subjects badly live to regret that fact. It is now proposed to show how these subjects fit foundry science.

Mathematics.—The first subject that must be compulsory is mathematics, and, what is more, mathematics to quite an advanced standard. By that is meant that not only it must include calculus, but that it must take in a little of the Bessel functions. The need for that is obvious. Fully to understand what goes on in a solidifying casting is impossible without being good at heat flow. That is difficult enough, but in foundrywork one is concerned with what is known as unsteady heat flow, and that needs an understanding of Bessel functions. On this matter the Author can speak with some feeling, because the subject of heat flow has been of direct interest to him both in his engineering work and in his foundry studies. Mathematics taught to him at the university did not go far enough, with the result that ever since he had to tackle heat flow the hard way, and the way that takes much longer.

Many founders have seen that fascinating little book by Ruddle called "The Solidification of Castings." How many can truthfully say that the mathematics part of it was understood, and if the mathematics were omitted, how much would be left of the book? Paschkis has been working for years with an electrical apparatus plotting the manner in which steel solidifies. In this apparatus, flow of electricity is used in place of flow of heat, and the study is carried out on a laboratory table, which is more comfortable than handling hot molten steel. It is an investigation of considerable importance, but have readers been able to understand it? Personally, the Author found it heavy going. This need for advanced mathematics implies a three-year study.

Hydraulics.—The next subject obviously of interest to the foundry scientist is hydraulics, or the flow of liquids. The flow of liquid metal is subject to the same laws as the flow of any other liquid, but with the one difference—that it is a good deal more difficult to make calculations, because the properties of liquid metal are changing all the

* Paper presented to the Ironfounders' National Confederation Conference at Scarborough.

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time. Another complication is that the metal flows mostly through passages with porous walls, with the result that, at any point of low pressure in the flow channel, air can be sucked into the metal stream. The third complication is that oxide films can form at the surface of molten metal, while ordinary liquids do not form such films. In light alloys and in steel, such films are whipped up and produce discontinuities and skin imperfections. It should now be clear that hydraulics as taught to the foundry scientist must be of even higher standard than that taught to an engineer. At least, water, with which the engineer has to deal, remains water from one end of the pipe to another. So at least two years should be spent on hydraulics. Further applications of the flow of fluids are such matters as the flow of vapour and gases through the sand. Ventilation and dust extraction comprise a mixture of fluid dynamics and heat flow, and a good knowledge of these subjects will help the foundry scientist to get the best results from their practical application.

Strength of Materials.—The last basic subject is strength of materials. To a foundryman the strength of materials matters from the very begining of his work. As soon as the mould is made he asks: is the green-sand strong enough? Will it support the weight of the cores? Will it yield under the pressure of metal? Will the cores be broken by the buoyancy forces? The avoidance of hot-tears in steel or gunmetal is another application of the principles of the strength of materials, and is much easier if one has been taught some of the basic formulæ.

Looking farther ahead, all castings are strength members of structures or machines. They have to carry loads. and just as the engineer has to know how to calculate the stresses in the parts of his machines. so it is important for the foundryman to understand them. because he is making the components for the engineer. and his job is considerably easier if both speak the same language. The Author admits that he sees no need for the strength of materials to be taught to a very high standard—one year's course should answer.

Specialized Subjects

Besides these general subjects that underlie all technology are subjects entirely peculiar to foundries. An example of this is the principles of solidification of castings. This matter has been developed to a reasonable standard only in the last 15 years or so. In particular, the Author would refer to such work as that done in the U.S.A. by Brinson and Duma on the padding of steel castings to ensure perfect feeding; to the work of Bishop and Pellini on the feeding of plates and rods. and to the work of Myskowski, Bishop and Pellini on the effect of chills. This work has been done in a thorough and convincing scientific manner, and one cannot help but be very impressed with it.

In this country there is the work of Ruddle and his colleagues at the British Non-Ferrous Metals Research Association on the flow of heat in moulds and on the solidification of metals. The British Steel Castings Research Association is said to be working on the problem of solidification of castings, but at the moment the Author has no exact information on this subject. Such experiments have now reached a point at which the subject can be taught because they have uncovered some of the underlying principles and have produced numerical data that can be imparted to students. Reading through the original papers, one may think them contradictory and not obviously of practical utility, but that is where thoughtful analysis by a competent teacher proves its worth. It can be asserted that the results are usable right now.

The science of sands and their behaviour in foundries is now quite advanced; and I am glad to say that much of this position is due to work done in England by the British Cast Iron Research Association. Good work has also been done in America by such people as Dietert. Interesting work has also been carried out in Germany, but because the results are written in a foreign language, it has not received much publicity, particularly among the rank and file of foundry technologists. When reference is made to sand science, most people think just in terms of the properties of sand moulds and cores at room temperature. What the sand does when it is surrounded by hot metal one prefers not to question; yet that behaviour is just what does matter. Why is it disregarded—just because it is a little difficult! The ideal foundry scientist would be on familiar ground when dealing with sand at the temperature of molten metal. He would have done the experiments which foundrymen not only have not done, but have not even seen.

An important phase of sand science is drying of moulds and drying of cores—two very different matters. It is a subject well understood, for example, by Mr. Parkes of the British Cast Iron Research Association, but few would care to stand up and deliver a short lecture on the basic principles of drying. Drying of a mould is an exercise in physics because it concerns simple evaporation of water; drying of cores, on the other hand, concerns combination of core compounds with oxygen and is a practical application of chemistry. It is clear that the general subjects of physics and chemistry must also be taught to foundry students.

At this stage it should be realized that the subjects so far mentioned are taught at other science courses, for instance engineering, and that is true enough. A personal answer, however, is that technology is such a vast domain that the examples taught must be chosen to suit the particular field. The heat flow to an engineer is the heat flow through the cylinder walls of an engine; the heat flow to a foundryman is the flow from a solidifying casting, something quite different. In the course envisaged all the subjects would be given a foundry slant.

Practical Work

When any technology is taught at a university, the lectures are supplemented by practical work which is designed to give realistic proof of the scientific principles taught. Similarly, in the course envisaged, the practical work would duplicate some of the discoveries. For instance, experiments would be made to demonstrate the correctness of Brinson and Duma's conclusions on the feeding of castings. Such phenomena as gas pick-up from mould-reaction would be demonstrated, together with the effects of various remedies. When somebody teaches that the way to dry a mould is just to raise its temperature above 100 deg. C., this must be demonstrated. If someone says that coal-dust in green-sand produces more flexibility at high temperatures, it must be proved to the students.

It is essential, moreover, that each student should not merely stand by and watch; he must do the actual experiment. He must analyse the results, section the specimens, take gamma-ray photographs, measure the specific gravities and, finally, write a report. He must spend a proportion of his time in intimate testing of foundry machinery. If, for instance, the lecturer says that by jolting a mould there is greater firmness at the bottom of it, by squeezing it there is greater firmness at the top, and by impellor ramming there is uniform hardness throughout, this must be shown, tried, measured, and plotted on a curve. There is a world of difference between having made the test personally and reading about it in a book.

The trained student must be very familiar with testing the performance of a sand-mill, core-mixer, pneumatic rammer, various kinds of moulding machines, core-blowers, die-casting machines, centrifugal-casting machines, and so on. The various methods of non-destructive testing must be taught and personally tried out by the students. For actual moulding, core-making, cupola tending, etc., a little instruction should be given in the college workshops; the rest would be done during the summer vacation under the heading of practical experience, just as it is done by other students.

The above has been a brief survey of some of the subjects and the way they should be taught, so that being accomplished, it is proposed to just touch upon two other points. If it be decided that such a course as that outlined above is not needed, by what means is the young man to acquire the information he needs? At the moment he is expected to read through hundreds of papers on foundry subjects published every year, decide which of them talk sense and which are wrong, and then set out to teach himself the new knowledge. In doing that he does not even get the benefit of good knowledge of mathematics and he will need to be a very determined young man to make himself proficient in the foundry science. What is more, when he has taught himself, he will find that he is a "voice crying in the wilderness" because no one will understand what he is talking about.

Where are the lecturers, professors, if you like, coming from? The best source of such teachers will be the three research associations, the British Cast Iron Research Association, the British Non-Ferrous Metals Research Association, and the British Steel Castings Research Association. One might in addition find an odd man here and there at a university or in an industrial firm. There, there is a major difficulty: in Britain only a handful of people are qualified to teach in the course under discussion. This is perhaps in itself an argument for doing something about it.

It is postulated as axiomatic that teaching in every sphere, every industry must reach the highest standard. This is asserted on two grounds:—(*a*) That it is a divine duty to seek knowledge and enlightenment, and (*b*) that this country now has to rely on income derived from industrial exports. One sometimes obtains a better perspective of a subject by looking at the situation in other industries. Foundrymen and engineers work side by side and work to the same end. So let us see what is done in engineering. Britain leads the world in jet aircraft. These aircraft were designed in competition with the most highly-trained people in America and Germany. Could it be thought that Britain would have been in the same position if the key people in the aircraft industry were forced to receive their education at the level of a "City and Guilds" workshop course?

DISCUSSION

DR. J. G. PEARCE, O.B.E., director of the British Cast Iron Research Association, said that, in making a few comments on Dr. Ivanoff's paper, he would like to endorse most of what had been said, particularly the plea for high-level teaching of foundry science and its ancillary subjects. He thought he had scarcely done justice to the present situation, however, in suggesting that all foundry teaching was at the operative level, catered for by "City and Guilds" courses. He appeared to overlook the National Foundry College, for example. This one-year diploma course (or 18 months for those not fully prepared) was regarded as being at post-graduate level, although a degree was not essential for admission. The College was an entirely independent body, although all the research associations concerned with cast metals were represented on its governing body and their staffs participated in the specialized teaching. For the last five years, the staff of the British Cast Iron Research Association had given something like 20 lectures each session. To some extent, therefore, Dr. Ivanoff's suggestion was already in operation.

Requirement from the Industry

There was now undoubtedly a sufficient body of knowledge in existence to justify a course in foundry science at university level. As the Author had indicated, it was wider than foundry metallurgy, but he doubted whether it should be taught at more than one or two centres. Whether that would be achieved—and this was his main point—depended, in his personal opinion, on the industry. The connection might not at first sight be clear, but if one examined the number and variety of professional Chairs created during the past few years, it would be seen that the universities were unlikely to have any objection. It depended upon

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the industry, because courses were provided for students, and students would only take such courses if the foundry industry offered a worthwhile career. To-day a graduate found his way to the foundry industry by accident rather than design. Formerly, intelligent men grew up who could have profited by university training, but did not get it, and they advanced to responsible work in spite of that. To-day it was not a question of whether the industry wanted university men, but of whether it wanted intelligent men at all, because intelligent men were now all able to get a university education. The great engineering, chemical and other firms and scientific bodies systematically combed the universities for recruits even before they had taken their final examinations. What chance had the foundry industry? Few foundries were big enough to take a new graduate every year. Since the industry employed 150,000 people, and something like one in 25 should have a superior education, it was obvious that, estimating on a working life of 40 yrs., the industry needed 100 recruits each year, of which the Foundry College was now providing roughly one-fifth. It was not suggested, of course, that more than a fraction of this hundred needed training in the higher technology of the industry on the lines suggested by the Author, but certainly a proportion so trained would justify itself.

Co-operative Action

Although no foundry was big enough to act alone, he saw no reason why the foundry industry should not act together in this way through its representative institutions, the leading trade associations. A given small number of recruits might be absorbed per annum and the research associations might act as a suitable "cushion," pending their joining firms, when their entry was for some reason delayed. Indeed, this might form part of their training.

What the universities insisted on was the use of particular fields of knowledge to teach men to think logically and to inculcate a mental discipline which would enable students to go on learning, so that they could bring a critical mental apparatus to bear on every proposition, every addition of knowledge, technical article, paper or Patent they come across.

State of Affairs Abroad

He was encouraged in these views by the practice of other industrial countries with which this country had to compete. Castings had enormous potentialities for the future and some remarkable developments had taken place in the last few years. In Germany, the teaching of foundry science at university level was a commonplace and had been carried on for over a quarter of a century. At its largest university, Aachen, the four-year metallurgy course could be specialized in foundry science during the last two years, and this had absorbed 30 students a year. This instruction was carried on in the Foundry Institute, a new six-storey building which was perhaps the most impressive feature of this town of Charlemagne. Thus, 30 graduates a year were fed into the foundry industry of a country which had smaller foundry output than our own, and their absorption was so normal a procedure that no specially-organized arrangements seemed to exist. In France, the central trade association picked and sent each year to the Foundry High School in Paris, which is run much like the (British) National Foundry College, about 24 graduates from the great French high schools, whose qualifications would compare very favourably with British graduates. Presumably these students would be convinced that the industry offered worthwhile careers. In this country, it was much easier than in the countries mentioned for a man to make his way from the bottom to the top of the ladder of success, and this was a feature of the system one would do well to preserve. Nevertheless, it must be expected that it would become less and less likely for a man to reach the highest positions in the industry unless he had been trained at a university or equivalent institution.

The position in the United States was different in that a much larger proportion of men were trained in technology at the State universities and institutions, and in these metallurgy was usually treated as part of the work of the engineering department. Training in technology to the highest levels was available in some of the more outstanding universities and schools of technology, which had a Federal and even an international reputation.

One further point might be mentioned. If recruits at university level were needed in the British foundry industry, he suggested that they might well be found among graduates of the great schools of engineering, because there were many more students of engineering than of metallurgy, and, after all, the production of castings was mainly an engineering job. Engineering students expected to take some form of apprenticeship training and this could readily take the form of facilities for training in the foundry. The industry would find such men of great value on the production side, and possibly more useful in many foundries than metallurgy students, who did not commonly expect to take an apprenticeship.

He naturally welcomed the Author's suggestions that the staffs of the research associations might be drawn upon for advanced teaching in foundry subjects, and the speaker had indicated that in one direction this was already being done. Also, they already gave occasional lectures to university students and senior staff were sometimes called upon to act as examiners for higher degrees. They could, therefore, be regarded as fully competent to undertake work of this kind.

COCKBURNS, LIMITED, valve makers, Cardonald, Glasgow, have taken office premises at 175, Piccadilly, London, under the management of Capt. (E) G. R. Cook, R.N. (RETD.). This office will deal with sales and maintenance for the London area and home counties.

Effect of Heat on Clays and its Bearing on the "Life" of Clay Bonds*

By S. Davidson, B.Sc., and J. White, D.Sc.

(*Continued from page* 174)

(3) CHANGES IN PROPERTIES ON HEATING.

To investigate the effects of temperature on the properties of the clays, large samples were heated in an oxidizing atmosphere for 24 hrs. at temperatures ranging from 110 to 900 deg. C. The tests described below were then carried out on these samples.

(*a*) *Bonding Properties.*

Mixtures of the heated clays with washed Chelford sand were prepared by milling at various moisture contents, the clay addition being 5 per cent. of the weight of the sand in the case of the montmorillonites and 7.5 per cent. of the weight of the sand in the case of the kaolinites. Green- and dry-strengths (the latter after drying for 2 hrs. at 200 deg. C.) were then determined on A.F.S. test-pieces rammed 10 times with the standard A.F.S. rammer. The curves of green- and dry-strength against moisture content are shown in Figs. 3, 4, 5 and 6.

Green-strength: With all of the clays, the peak strength falls progressively with increasing temperature of treatment, while the moisture content at the peak tends to increase. This latter tendency is particularly marked in the case of the two kaolinitic clays, and with heat-treatments between 300 and 500 deg. C. the curves move progressively to the right, so that the strength at a given moisture content beyond the peak increases. With the samples heated to over 600 deg. C., in which decomposition of the clay would be practically complete (as shown in Fig. 2), this movement of the peak to the right appears to have been arrested and a fall in strength occurs. The effect of these variations on the strength at a constant moisture content of 4.0 per cent. is shown in Fig. 10. In each case, the measured strength rises to a maximum at about 500 deg. C., *i.e.*, within the dehydration range, before it finally falls. It should be emphasized, however, that though the measured strength increased up to 500 deg. C. the plastic properties of the sand mix as judged by feel and mouldability deteriorated progressively with increasing temperature.

With the montmorillonites, the movement of the

* Paper presented to the fiftieth annual meeting of the Institute of British Foundrymen at Blackpool.

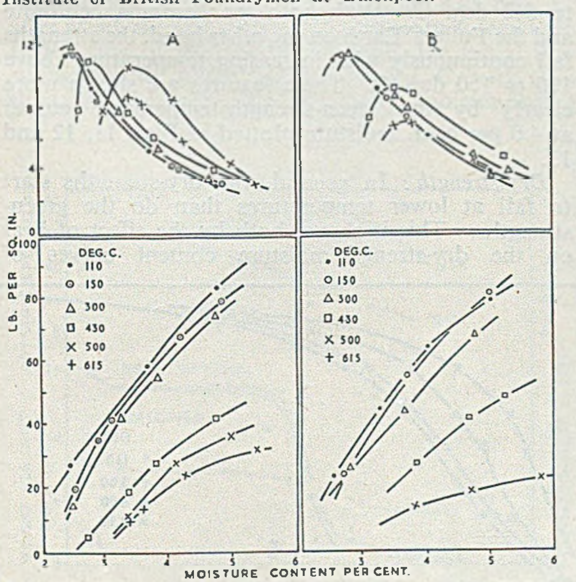

FIG. 3.—*Variation in Green-strength (upper) and Dry-strength (lower), over a Range of Moisture Contents, of Chelford Sand bonded with 7½ per cent. additions of (A) Newton Abbot Ball Clay heated at Various Temperatures and (B) Plastic Kaolin. (A.F.S. Test-pieces rammed 10 times, and, for the Dry Tests, dried at 200 deg. C. for 2 hrs.).*

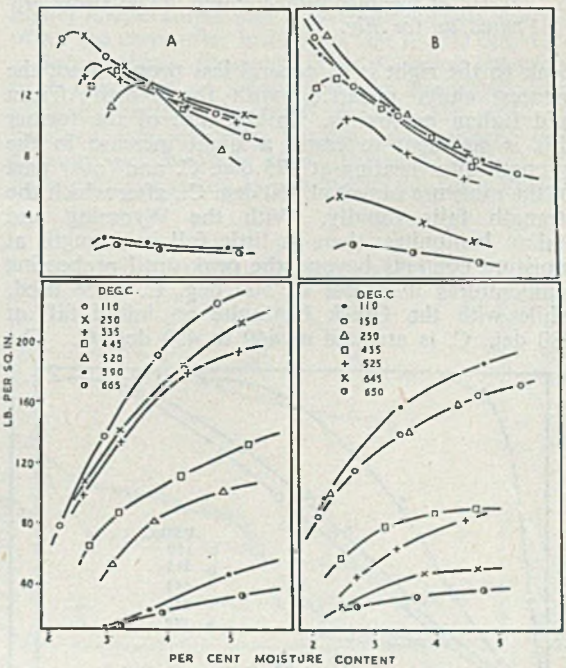

FIG. 4.—*Variation in Green-strength (upper) and Dry-strength (lower), over a Range of Moisture Contents of Chelford Sand bonded with 5 per cent. additions of (A) Italian, and (B) Wyoming Bentonite heated at Various Temperatures. (Test-pieces prepared as for Fig. 3.)*

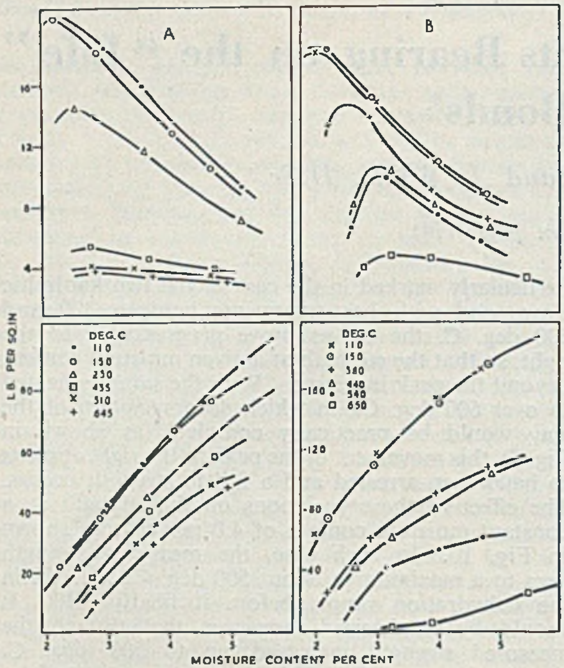

FIG. 5.—*Variation in Green-strength (upper) and Dry-strength (lower), over a Range of Moisture Contents, of Chelford Sand bonded with 5 per cent. additions of (A) Pembina, and (B) Greek Bentonite heated at Various Temperatures. (Test-pieces prepared as for Fig. 3.)*

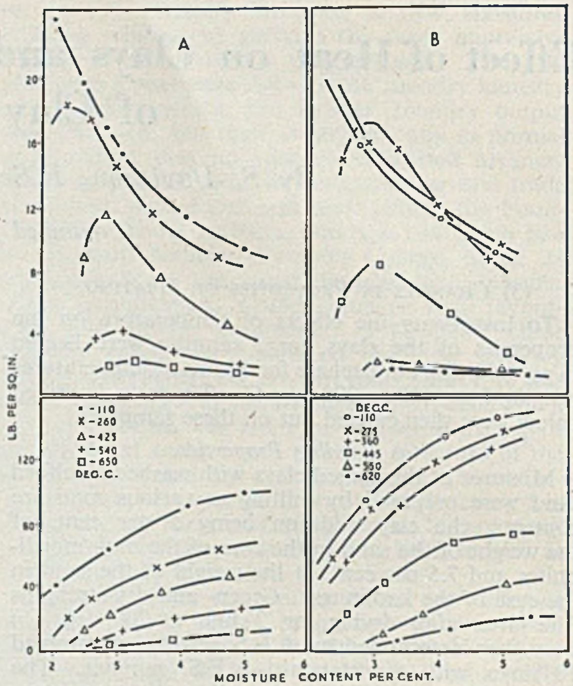

FIG. 6.—*Green-strength (upper) and Dry-strength (lower) over a Range of Moisture Contents, of Chelford Sand bonded with 5 per cent. additions of (A) Natural Fullers' Earth and (B North African Bentonite heated at Various Temperatures. (Test-pieces prepared as for Fig. 3.)*

peak to the right is in general less pronounced, the greatest shifts occurring with the North-African and Italian bentonites. In the case of the former this is sufficient to cause a slight increase in the strength after heating at 275 deg. C. and (over part of the moisture range) at 360 deg. C., after which the strength falls rapidly. With the Wyoming and Italian bentonites, there is little fall in strength at moisture contents beyond the peak until preheating temperatures in excess of 500 deg. C. were used, while with the Greek bentonite an initial fall at 380 deg. C. is arrested at 440 to 450 deg. C. The strength then falls to low values in the sample heated to 640 deg. C. With both the Pembina bentonite and the Fullers' Earth on the other hand, the strengths fall continuously with increasing temperature above 110 to 150 deg. C. These features are shown more clearly by the green-strength/temperature curves at 4.0 per cent. moisture plotted in Figs. 11, 12 and 13.

Dry-strength: In general, the dry-strengths start to fall at lower temperatures than do the green-strengths. This is shown both by the effect of heat on the dry-strength/moisture content curves of

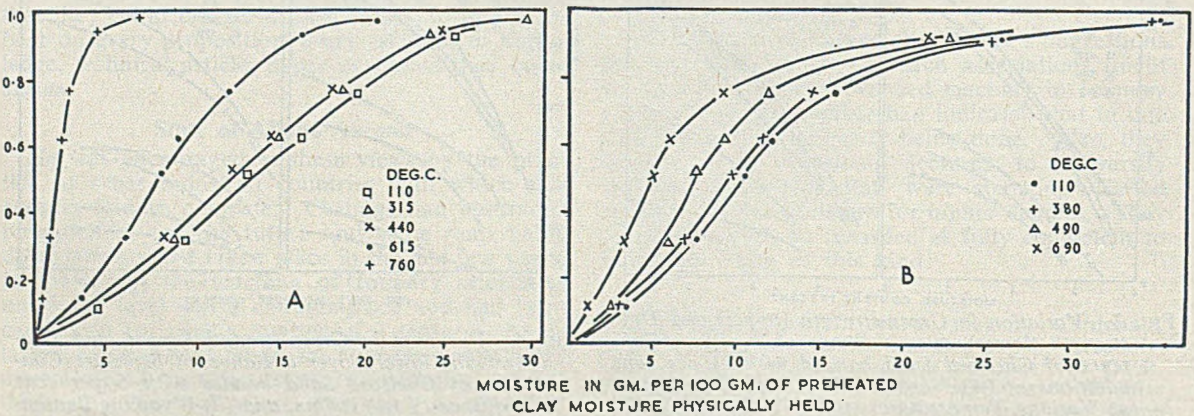

FIG. 7.—*Vapour-pressure Isotherms at* 30 *deg. C. of (A) Wyoming, and (B) Greek Bentonite after Heating at Various Temperatures.*

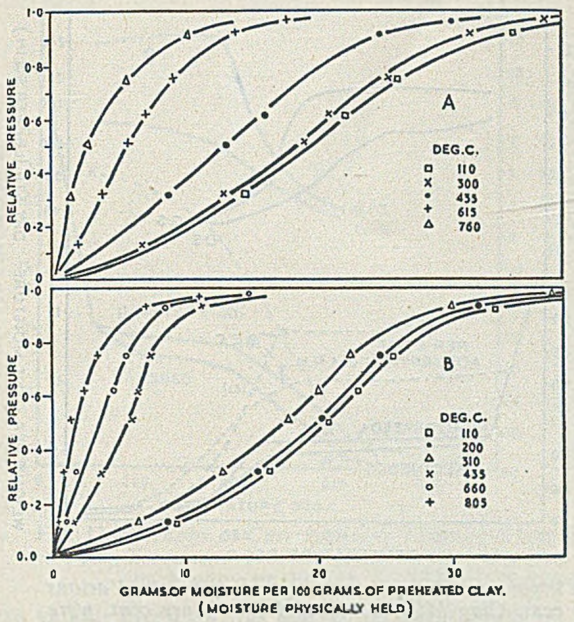

FIG. 8.—*Vapour-pressure Isotherms at 30 deg. C. of (A) Natural Fullers' Earth, and (B) Pembina Bentonite after Heating at Various Temperatures.*

Figs. 3, 4, 5 and 6 and also by the dry-strength temperature curves at 4.0 per cent. moisture shown in Figs. 10, 11, 12 and 13. With the china clay, this fall-off in strength first becomes apparent after heating to 300 deg. C. and increases regularly with increasing temperature, while with the ball clay a rapid drop occurs between 300 and 430 deg. C. after which the rate of fall with temperature decreases. In the case of the montmorillonites, the initial dry-strengths after preheating at 110 deg. C. vary considerably, the values at 4.0 per cent. moisture being

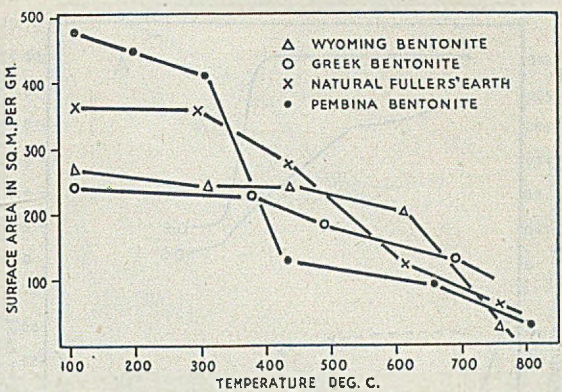

FIG. 9.—*Curves showing the Effect of Prior Heat-treatment on the Surface Areas of Various Clays as Calculated from their Water Absorption Isotherms using the B.E.T. Equation.*

170, 190 and 160 lb. per sq. in. approximately with the Wyoming, Italian and Greek bentonites and 70, 130 and 100 lb. per sq. in. with Pembina bentonite, North-African bentonite and the Fullers' Earth. With increasing temperature of pre-treatment, the Wyoming, Italian and North-African bentonites suffer only a small diminution in strength up to 300 deg. C. while the Greek bentonite again loses its strength in two distinct stages. With the Pembina bentonite and the Fullers' Earth, on the other hand, the strength falls continuously from 110 to 150 deg. C., though with the former the rate of fall is so slow at higher temperatures that it gives the highest strength of all the clays after heating to 600 to 700 deg. C.

Base-exchange Capacity: Base-exchange capacities were measured on samples of the preheated clays using the method described earlier. The curves of base-exchange capacity against pre-treatment temperature are shown in Figs. 10, 11, 12 and 13, the base-exchange values for convenience being expressed

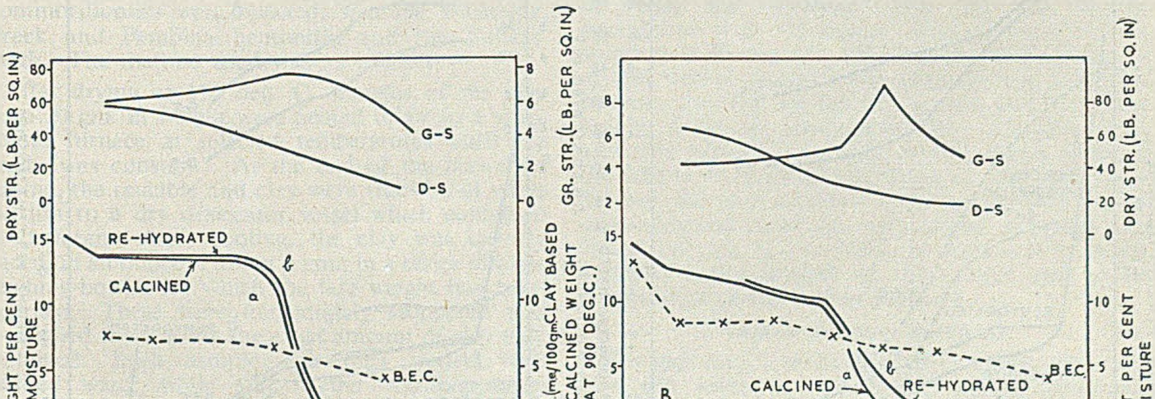

FIG. 10.—*Graphs for (A) Plastic Kaolin, and (B) Newton Abbot Ball Clay of* (1) *Green-strength at 4 per cent. Moisture, and* (2) *Dry-strength against Calcination Temperature of Chelford Sand/7½ per cent. Clay Mixes;* (3) *Base-exchange Capacity against Calcination Temperature, and* (4) *Moisture Content (based on Calcined Weight of Clay at 900 deg. C.),* (a) *after Heating to Various Temperatures, and* (b) *after Heating followed by Re-wetting and Drying at 110 deg. C.*

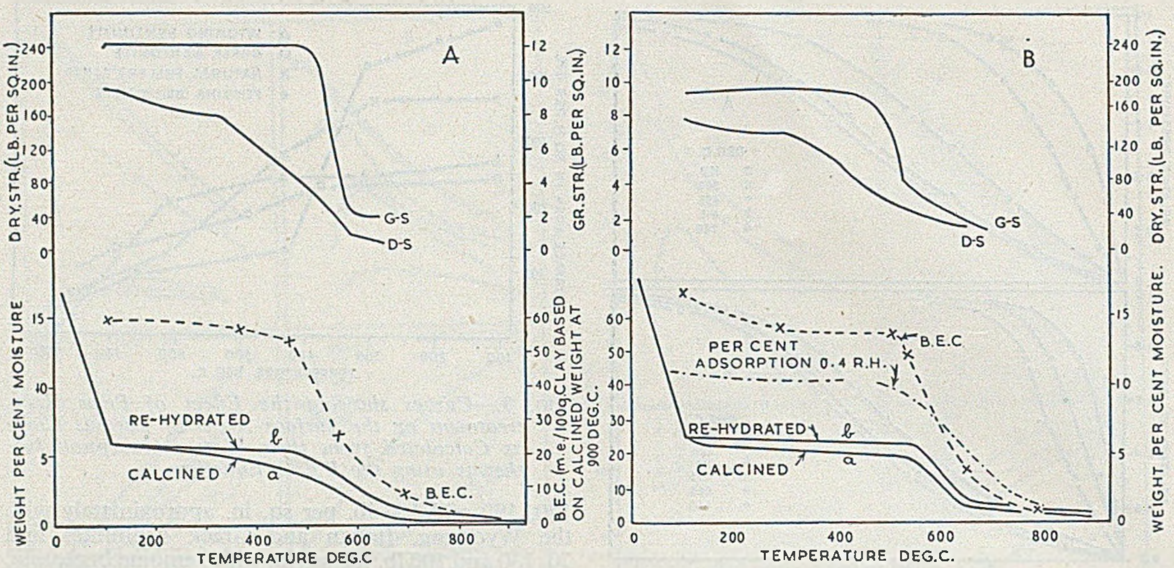

FIG. 11.—*Similar Values for (A) Italian, and (B) Wyoming Bentonite corresponding to the Various Treatments detailed for Fig. 10, except that 5 per cent. Clay Mixtures instead of 7½ per cent. were used. Graph (B) for Wyoming Bentonite also includes (5) Moisture Adsorption at 30 deg. C. and 0.4 Relative Humidity against Calcination Temperature.*

on the basis of the weight of clay to give 100 gm. of residue after calcination at 900 deg. C. It will be seen that the curves for the kaolinitic clays apparently indicate a slow, progressive fall in base-exchange capacity over the entire range. In the case of the montmorillonites, the curves are of two types, those for the Wyoming and Italian bentonites and to a somewhat less extent the Greek bentonite indicating only a slight fall in base-exchange capacity up to a temperature of 400 to 500 deg. C., while with the other three clays the base-exchange capacity falls continuously from room temperature upwards. The significance of this is discussed later.

(b) *Moisture Adsorption and Surface Area.*

Vassiliou and White[12] have investigated the relationship between moisture adsorption and vapour pressure of several bonding clays. From a consideration of their experimental vapour-pressure isotherms, they concluded that the first stage of adsorption at

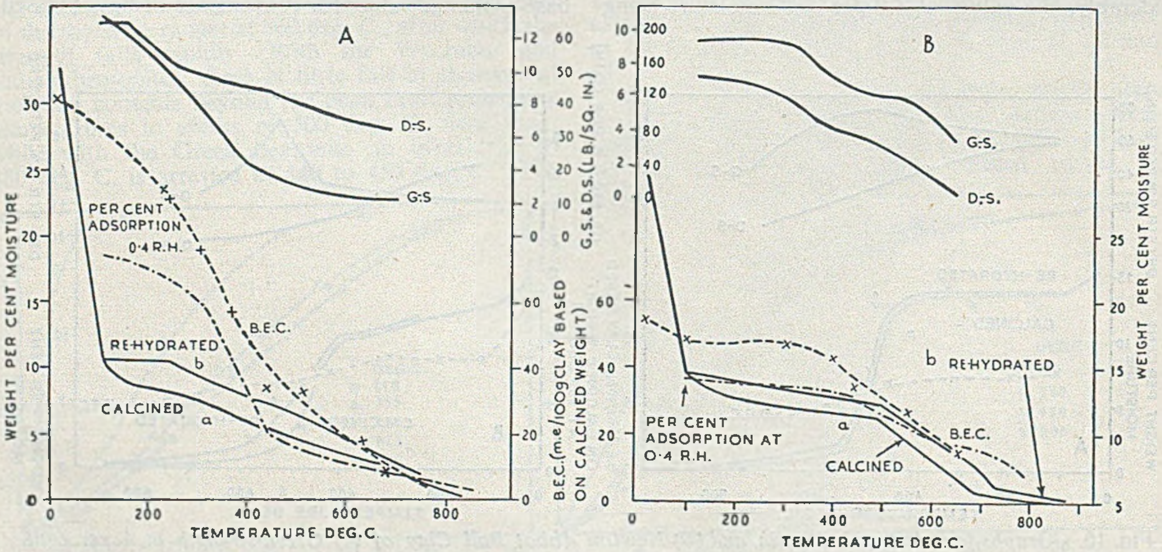

FIG 12.—*Graphs for (A) Pembina, and (B) Greek Bentonite of Results from Similar Treatments to those detailed for Fig. 10, except that, in this Case also, 5 per cent. Clay Mixtures instead of 7½ per cent. were used, and (5) Moisture Adsorption per cent. at 30 deg. C. and 0.4 Relative Humidity against Calcination Temperature is plotted.*

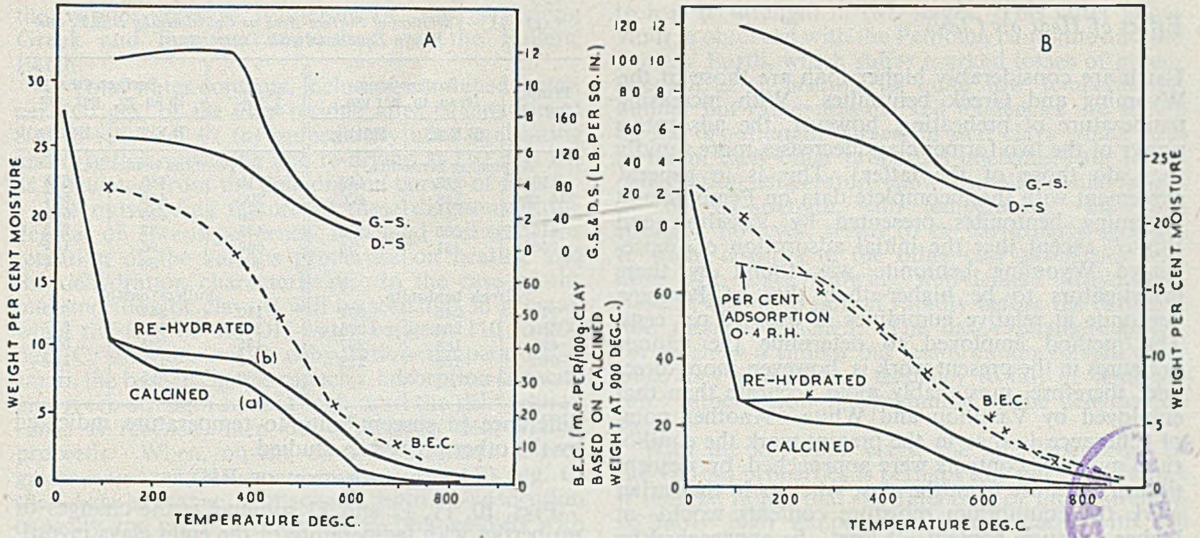

FIG. 13.—*Graphs of Corresponding Values for (A) North African Bentonite, and (B) Natural Fullers' Earth, for Treatment set out for Fig.* 10, *but with* 5 *per cent. Clay Mixes, and* (5) *(for B only) Moisture Adsorption at* 30 *deg. C. and* 0.4 *Relative Humidity against Calcination Temperature.*

low vapour pressures was due to the formation o af mono-molecular film on the clay surfaces and hydration of the exchangeable cations. At higher vapour pressures, further adsorption took place with thickening of the water film due to the osmotic activity of the exchangeable cations and filling of the smaller pores due to capillary condensation. They also used the Brunauer-Emmett-Teller equation to calculate the surface areas of their clays and showed that it decreased as the clay was heated to progressively higher temperatures.

As part of the present investigation it was considered worth while to extend this work since it was likely to provide additional informaton on the effect of heating on the clays investigated. Since time did not allow all eight clays to be studied in this way, four of the montmorillonites were selected, *viz.*, the Wyoming, Greek and Pembina bentonites and the Fullers' Earth. The method used was as follows:—

After drying at 110 deg. C. samples of the clay 15 to 20 gm. in weight were heated in air in a wire-wound furnace at selected temperatures until the weight was constant. At the end of the period of heating, the crucible and clay were transferred while still hot to a dry desiccator vessel which contained no desiccant. After cooling, the clay was quickly placed, in amounts of about 2 gm., in a series of glass weighing-bottles for which the tare weight had been recorded. These were immediately stoppered and re-weighed to ascertain the exact amount of clay they contained. Each sample was then wetted with distilled water while still in the weighing-bottle, which was then suspended, with the stopper removed, over a saturated salt solution of known vapour pressure (see Appendix I), in a Pyrex boiling-tube, fitted with a one-hole rubber stopper through which passed a short length of glass tubing connected—by means of about 3 in. of rubber pressure-tubing—to a second and rather longer piece of glass tubing. The insert of rubber tubing was to allow the boiling tube to be sealed off, when required, by means of a screw clip. The weighing-bottle containing the clay was suspended by means of wire thread from a small wire hook pushed into the rubber stopper. After placing the clay in the boiling tube and inserting the stopper, the tube was slowly evacuated by connecting the outlet tube to a rotary vacuum pump, then sealed off by means of a screw clip and immersed in a water-bath controlled at 30 deg. C. where it was left until the clay had ceased to lose moisture to the salt solution. Generally, periods of from one to two weeks were necessary for the weight to become constant. (This was determined by removing the weighing-bottle, re-weighing it, replacing it in the boiling-tube, re-evacuating and continuing the treatment for a further few days until no further change in weight was observed.) The clay was then in equilibrium with the vapour pressure over the salt solution at 30 deg. C. The total moisture taken up at this vapour pressure was given by the difference between the final weight of the clay and the initial weight of the clay after calcination. The physically-adsorbed moisture was taken as that driven off when the sample was re-dried at 110 deg. C. The difference between the total moisture taken up and the physically-adsorbed moisture, representing moisture not lost at 110 deg. C., was found to depend only on the previous heat-treatment of the sample and to be independent of the vapour pressure.

Vapour-pressure Isotherms

For each clay, a series of determinations was made over salt solutions of different vapour pressures. Vapour-pressure isotherms were then constructed for each of the samples by plotting physically-adsorbed moisture, as the weight of water adsorbed per 100 gm. of the preheated clay, against vapour pressure. The curves obtained for each of the four clays after preheating to various temperatures are shown in Figs. 7 and 8. It will be seen that the initial adsorptive power of the Pembina bentonite and the Fullers'

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Earth are considerably higher than are those of the Wyoming and Greek bentonites. With increasing temperature of preheating, however, the adsorptive power of the two former clays decreases more rapidly than do those of the latter. This is in general agreement with the incomplete data on Pembina and Wyoming bentonites presented by Vassiliou and White[12] except that the initial adsorption of unpreheated Wyoming bentonite was found by these investigators to be higher than that of Pembina bentonite at relative humidities of over 90 per cent. The method employed to determine the vapour pressures in the present work is, however, more direct and, therefore, presumably more accurate than that employed by Vassiliou and White. Another point of difference is that in the present work the equilibrium moisture contents were approached by desorption of moisture from the clay, whereas in the earlier work the equilibrium moisture contents would—at higher moisture contents at least—be approached by adsorption. It is known that considerable differences can occur between the adsorption and desorption isotherms of a given clay within certain moisture ranges.

The variation with pre-treatment temperature in the moisture adsorption at 40 per cent. relative humidity for the cases of the four clays examined is shown in Figs. 11, 12 and 13. This humidity, as was pointed out by Vassiliou and White, corresponds approximately to the point of inflexion on the isotherms, which can be taken as giving a rough indication of the moisture required to form a mono-molecular layer over the surfaces of the clay particles. A more precise method is to fit the curves to the B.E.T. equation (as was also done by these workers), or to an alternative equation derived by Hüttig,[32] both of which permit an assessment of the moisture required to form a mono-molecular film (see Appendix B). From the calculated volume of the film, the surface area can then be estimated if a reasonable assessment can be made of the thickness of the film. X-ray measurements of the variation of the basal spacing with expanding lattice minerals indicate, as pointed out earlier, a value of the order of 2.5Å. Calculations based on the packing of water molecules in physically-adsorbed layers indicate a somewhat larger value than this, since they give the packing area of the water on the surface of the adsorbate as 10.8Å.^{2} per molecule.[14] This corresponds to a film thickness of approximately 3Å., if the film has the same density as liquid water. For the present purpose it was considered sufficiently accurate to assume the latter figure as holding. The surface areas calculated by the B.E.T. and Hüttig methods are shown in Table II and are seen to be of a similar order and to indicate a variation of a similar kind with temperature. The B.E.T. values are also shown graphically in Fig. 9 from which it will be seen that, while the areas of the Wyoming and Greek bentonites are relatively little affected by temperature up to 600 to 700 deg. C., those of the Pembina bentonite and the Fullers' Earth begin to decrease rapidly at temperatures much below this. This difference in behaviour is in keeping with the difference in susceptibility to temperature indicated by the other properties studied.

TABLE II.—*Variation of Surface Area as Calculated by B.E.T. and Hüttig Equations with Temperature.*

Temp., deg. C.	Surface area in sq. m. per gm.		Temp., deg. C.	Surface area in sq. m. per gm	
	B.E.T.	Hüttig.		B.E.T.	Hüttig.
Wyoming bentonite.			Pembina bentonite.		
110	273	449	110	480	573
315 and 440	248	426	200	449	507
			310	416	503
615	206	292	435	133	212
700	31	53	660	96	154
			805	33	44
Greek bentonite.			Fullers' earth.		
110	245	391	110	367	680
380	234	376	300	359	637
490	188	297	435	281	587
690	138	222	615	128	197
			760	55	—

CONSIDERATION OF RESULTS

Figs. 10, 11, 12 and 13 summarize the changes of properties with temperature of the eight clays investigated, the curves shown giving :—

1. Green- and dry-strengths of the sand mixes at 4.0 per cent. moisture as read off from the green- and dry-strength curves.

2. Base-exchange capacities per 100 gm. of the calcined weight of the clay.

3. Reversible moisture adsorption at 30 deg. C. and 40 per cent. relative humidity as read off from

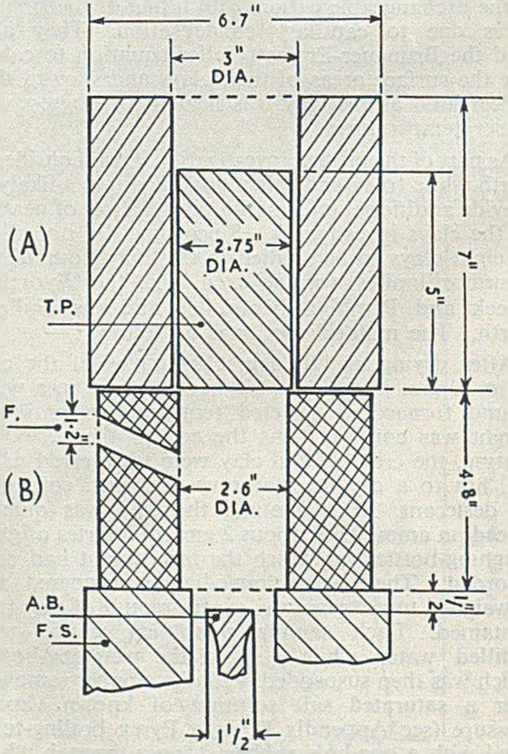

FIG. 14.—*Diagram of the "Life"-test Furnace. (A) Top Section of Furnace; T.P.=Sand/Clay Test-piece; (B) Bottom Section; F=Three Gas Flues set at 60 deg. angle; A.B.="Amal" Gas Burner and F.S.=Firebrick Support.*

the vapour-pressure isotherms of the Wyoming Greek and Pembina bentonites and the Fullers' Earth.

4. Total water contents, including combined water, per 100 gm. of the clay residue after calcination at 800 to 900 deg. C. (*a*) immediately after preheating and (*b*) after re-wetting and re-drying at 110 deg. C., as calculated from the dehydration curves of Fig. 2.

The outstanding feature of these diagrams is the degree of interdependence indicated between the retention of the various properties on heating and the dehydration characteristics. In the case of the montmorillonitic clays it will be seen that, in general, when the loss of the OH-water between 110 to 200 deg. C. and the initial dehydration temperature is small, the base-exchange capacity, adsorption capacity and green-strength remain high until the dehydration range is reached, then fall rapidly as dehydration proceeds. When, on the other hand, there is progressive loss of OH-water above 110 to 150 deg. C. the base-exchange capacity, moisture-adsorption capacity and green-strength all fall progressively with increasing temperature. The former behaviour is, it will be noted, characteristic of the Wyoming, Italian and North African bentonites (though the latter has a low initial dehydration temperature and, therefore, loses strength at relatively low temperatures) and to a somewhat less definite extent of the Greek bentonite, which, as already pointed out, tends

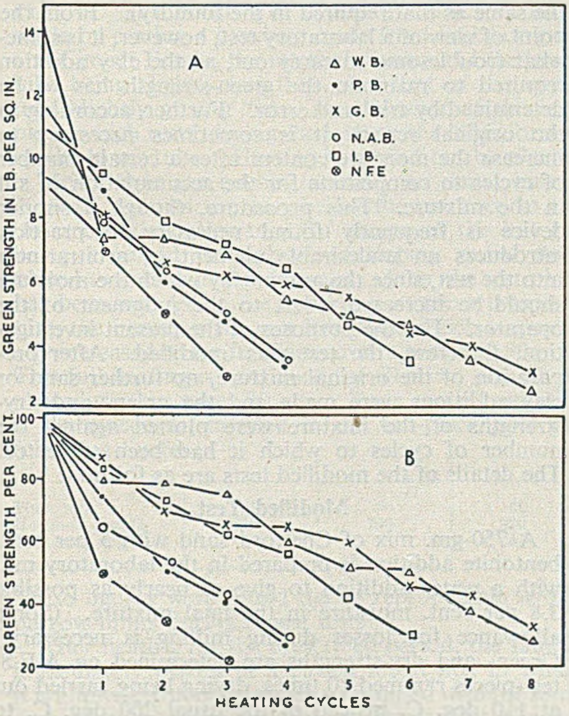

FIG. 15.—(*A*) *Green-strength "Life"-test Curves, and* (*B*) *Green-strength "Life"-test Values expressed as Percentages of Initial Green-strength remaining after each Heating Cycle for Wyoming Bentonite* (*W.B.*); *Pembina Bentonite* (*P.B.*); *Greek Bentonite* (*G.B.*); *North African Bentonite* (*N.A.B.*); *Italian Bentonite* (*I.B.*), *and Natural Fullers' Earth* (*N.F.E.*).

to lose its strength in two stages. This latter behaviour is observed with the Pembina bentonite and the Fullers' Earth, which suffer marked losses of green-strength after heating to quite low temperatures. Similar but rather less-marked tendencies are shown by the dry-strength curves, in that clays which tend to retain their other properties unchanged up to the dehydration temperature show a smaller initial falling off of dry-strength with temperature. The dry-strength, however, seems to be particularly sensitive to slight changes in the other clay properties and, even with clays showing well-defined dehydration steps, it begins to fall off rapidly before the dehydration range is reached. The base-exchange-capacity curves show a similar but less-pronounced sensitivity since they also show a tendency to fall at temperatures rather below the beginning of the dehydration step.

With the kaolinitic clays, the interdependence of the various properties is perhaps less obvious, though it may be noted that the retention of green-strength to fairly high temperatures is associated with the occurrence of a well-defined dehydration range. The indication that the base-exchange capacity is little affected by dehydration needs further investigation, since the method employed for determining base-exchange capacities is not very accurate at the low values characterizing these clays.

From the practical point of view, the most significant indication from the present work is that the sensitivity of bonding properties to temperature is so closely dependent on what are essentially chemical changes in the clay. This is at variance with the view that has been expressed, based on electron-microscope studies, that the deterioration in montmorillonites in use is due to fracture of the particles and consequent decrease in the plate size on heating. It does not, however, rule out the latter as a contributory factor determining "life."

Susceptibility of Clays to Heat

The present work throws some light on the nature of the factors which determine the susceptibility of a clay to heat. Thus it seems significant that the Wyoming, Italian and Greek bentonites which exhibit the greatest resistance are all apparently of the 5/2 montmorillonite type in which partial replacement of Al^{3+} by Mg^{2+} in the octahedral positions occurs. The Pembina, and North African bentonites and the Fullers' Earth, on the other hand, which are characterized as a group by high iron contents and low Si:Al ratios, are much less resistant to the effects of heating. This is in general agreement with the views expressed by Page[28] which were referred to earlier.

The close similarity in form between the dehydration curves and those showing the loss of base-exchange-capacity with temperature appears to indicate that the fixation of the exchangeable cations is intimately associated with the loss of OH-water. As mentioned earlier, Mering found that the fixation of the cations was accompanied by the formation of permanent ionic linkages, both between the layers of the crystals and between separate particles. To investigate this point, pellets

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prepared from four of the clays were immersed in water after being pre-heated to different temperatures and cooled. The following results were obtained:—

Preheat temp., deg. C.	Plastic kaolin.	Ball clay.	Wyoming bentonite.	Pembina bentonite.
110	Disintegrated rapidly	Disintegrated rapidly	Swelled slowly	Disintegrated rapidly
170	As above	As above	Swelled	As above
270	As above	As above	Swelled rapidly	Disintegrated slowly
450	Disintegrated slowly	Disintegrated slowly	Disintegrated rapidly	Disintegrated very slowly
540	No change	No change	Disintegrated slowly	No change
630	No change	No change	No change	No change

It will be seen that with the kaolinites, disintegration becomes slow at 450 deg. C. when dehydration has begun, and has ceased by 540 deg. C. when dehydration is almost complete, indicating that the formation of permanent bonds between the particles occurs as the OH-water is eliminated. In the case of Wyoming bentonite, low-temperature treatment increases the swelling rate, possibly because more rapid penetration of water occurs, due to some diminution in swelling capacity. By 450 deg. C., the swelling capacity has been destroyed, though disintegration still occurs. This becomes slower at 540 deg. C. and has ceased by 630 deg. C., when dehydration is complete. With Pembina bentonite, which is non-swelling, disintegration has already become slow at 270 deg. C. and has ceased at 540 deg. C.

These observations are consistent with the conclusions reached by Mering that permanent linkages between the particles are formed at lower temperatures in non-swelling Ca-montmorillonites than in Na-montmorillonites. The destruction of swelling capacity in Wyoming bentonite before it ceased to disintegrate in water suggests that the formation of linkages between the layers precedes their formation between the particles themselves. An attempt was made to demonstrate the difference in behaviour of the two bentonites in this respect by measuring their particle size distributions by means of the Andreasen pipette. In the raw state, no comparison could be made owing to the high gel-forming capacity of the Wyoming bentonite, but after heating to 400 deg. C. a marked difference in particle size was found, only 5 per cent. of the Wyoming bentonite being greater than 5 microns in size, as against 75 per cent. in the case of the Pembina bentonite.

(4) Laboratory Test of "Life" of Clays

As shown above, while the six montmorillonitic clays all lost most of their bonding properties when heated to temperatures over 600 deg. C. considerable differences were found to exist between them as regards their deterioration in the range 200 to 600 deg. C. Since, under actual casting conditions, a considerable depth of the mould is subjected to temperatures within this range, it seemed reasonable to suppose that the "life" obtained with these clays in service would vary in a similar manner. It remained to be seen whether this prediction could be substantiated by a laboratory test simulating actual conditions of use.

A laboratory test for assessing the "life" of bentonites for foundry use has been described by S. G. Henderson[33] the procedure being as follows: A standard mix of 300 gm. of silica sand plus bentonite is prepared at a suitable moisture content and the A.F.S. green- and dry-strengths are determined. The sand is then moulded in the A.F.S. test-piece mould box to produce a test-piece 5 in. high by 1¾-in. dia. which is placed with its axis horizontal in a metal holder for 15 min. over the flame of a "roaring Teclu burner." The holder is so made that the flame is conducted by the holder walls up each side of the test-piece and also past the ends. After cooling, the sand is milled with a standard moisture addition and tested. A standard amount of the mix is then replaced with fresh sand together with sufficient bentonite to bring the green-strength of the whole mix back to its original value at the same moisture content. This cycle is repeated 12 times. The bentonite addition required to maintain the original green-strength is taken as a measure of the "life" of the bentonite.

From the point of view of the foundryman, this test has the advantage that the result is given in terms of the clay addition required to maintain the green-strength unchanged, and is, therefore, readily translated into practice (though the actual clay addition required in the test will not necessarily be the same as that required in the foundry). From the point of view of a laboratory test, however, it is somewhat troublesome to carry out, as the clay addition required to maintain the green-strength has to be determined by trial and error. Further, according to the original report, it is sometimes necessary to increase the moisture content after a certain number of cycles to compensate for the accumulation of silt in the mixture. This procedure, though a similar device is frequently found necessary in practice, introduces an undesirable element of arbitrariness into the test, since the amount by which the moisture should be increased is left to the judgment of the operator. For the purposes of the present investigation, therefore, the test was modified. After preparation of the original mixture, no further sand or clay additions were made and the green- and dry-strengths of the mixture were plotted against the number of cycles to which it had been subjected. The details of the modified tests are as follows:

Modified Test

A 750-gm. mix of Chelford sand with 5 per cent. bentonite addition is prepared in the laboratory mill with a water addition to give as nearly as possible 3.8 per cent. moisture in the final mixture. (Some allowance for losses during milling is necessary.) Green- and dry-strengths are determined on A.F.S. test-pieces rammed 10 times, drying being carried out at 110 deg. C. instead of the usual 200 deg. C. to avoid the possibility of any change in the clay properties at this stage. All the material from the test-pieces is then returned to the batch, which is rammed by hand in a cylindrical brass tube to form a cylinder 2¾-in. dia. by about 5 in. high, which is then stripped from the former, dried at 110 deg. C. and heated on

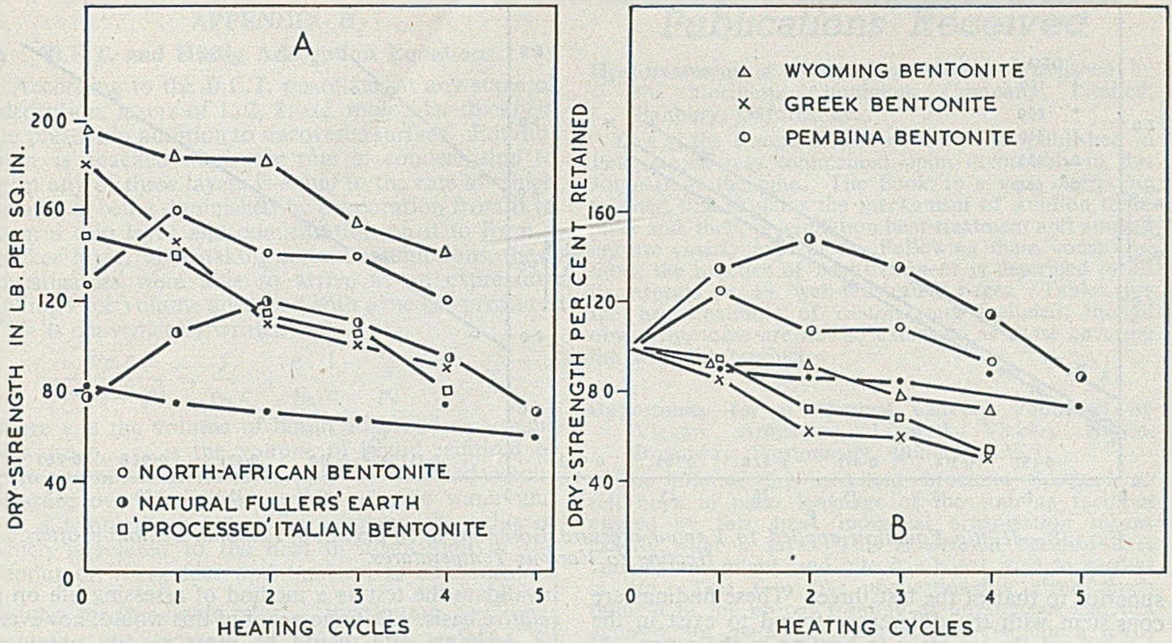

FIG. 16.—(*A*) *Dry-strength "Life"-test Curves of Various Clays, and* (*B*) *Dry-strength "Life"-test Curves expressed as Percentages of Initial Dry-strength retained after each Heating Cycle.*

one of its circular ends in the apparatus shown in Fig. 14. This consists of two short refractory tubes made by casting a concrete made from firebrick grog and Ciment Fondu, the internal diameter of the lower tube being slightly less than, and that of the upper tube slightly greater than, the diameter of the test-piece, which rests, during the test, on the ledge formed by the lower tube. Heating is carried out by placing a Meker-type gas burner (actually an Amal burner is used) with its top just below the entrance to the lower cylinder, allowance for escape of the hot gas being arranged through three sloping radial flues placed as shown in the diagram. After the test-piece has been inserted in the apparatus at room temperature, the burner is lit on a low flame which is gradually increased to the full flame over a period of 30 min. This full heating is continued for 60 min.; the whole procedure thus takes 90 min. Tests carried out with a thermocouple inserted in the test-piece gave the following figures:—

Time, min.	30	60	90
Hot face, deg. C. ..	610	750	820
Cold face, deg. C. ..	30	52	57

These figures were found to be reproducible within narrow limits during repeat tests.

After heating for the prescribed period, the sand is immediately placed in a closed metal box in which it is allowed to cool. It is then re-milled with the same percentage moisture addition as that used previously, and tested for green- and dry-strength. The same procedure is repeated during each cycle.

Test Results

Figs. 15 (A) and 16 (A) show the results obtained for the six bentonites, green- and dry-strengths being plotted against the number of heating cycles. In Figs. 15 (B) and 16 (B) the same results are re-plotted to show the percentage of the initial strength retained after each cycle. It will be seen that the green-strength results fall roughly into two groups, the fall off of strength with the Wyoming, Italian and Greek bentonites being much more gradual than with the Pembina bentonite, North-African bentonite and Fullers' Earth, *i.e.*, the "life" of the first three, as measured by the retention of green-strength, is

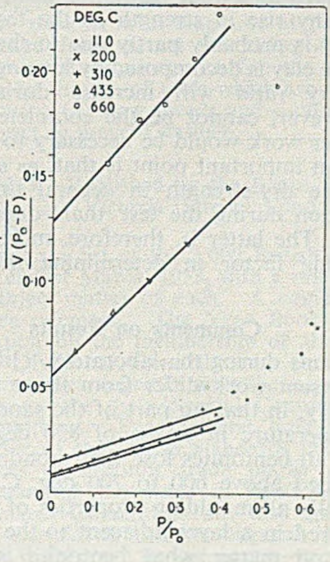

FIG. 17.—*B.E.T. Plots from Vapour-pressure Isotherms at 30 deg. C. of Pembina Bentonite, after Heating to Various Temperatures.*

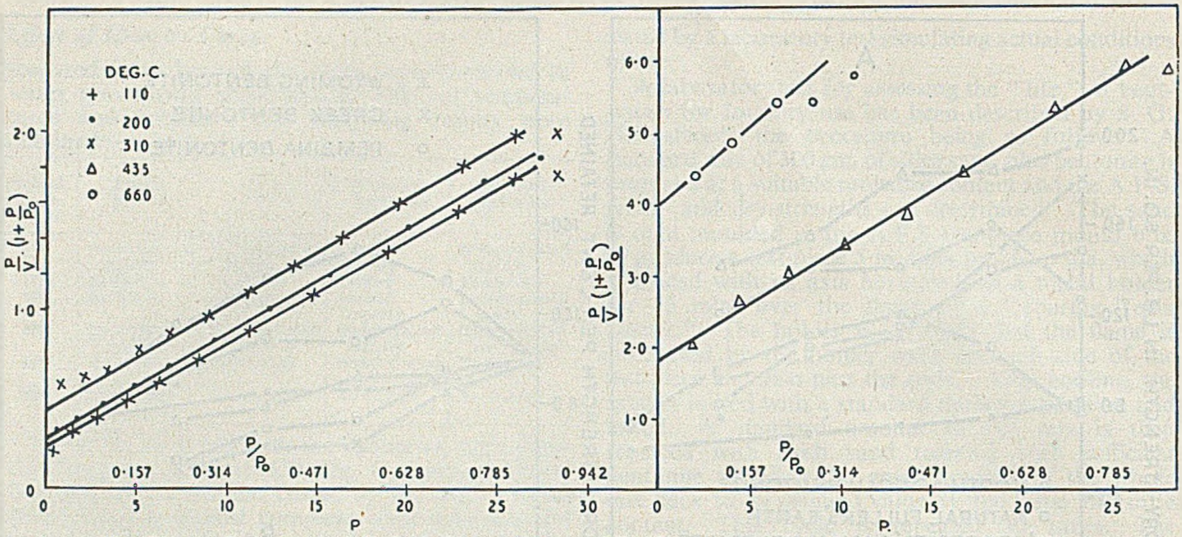

FIG. 18.—*Hüttig Equation applied to Vapour-pressure Isotherms at* 30 *deg. C. of Pembina Bentonite, after Heating to Various Temperatures.*

superior to that of the last three. These findings are consistent with the differences found to exist in the response of the six clays to heating in the range 200 to 600 deg. C.

The results of the dry-strength measurements are more difficult to classify. Somewhat unexpectedly, the three bentonites which have the least resistance to heat as assessed by green-strength are apparently least subject to deterioration on dry-strength and, with the North-African bentonite and the Fullers' Earth, it will be seen that an increase in dry-strength actually occurs. From the circumstance that both of these clays were of the non-swelling calcium type and contained calcite it was thought that the presence of the latter constituent might be responsible for the rise in strength. Experiments in which calcium carbonate was added to the Greek bentonite, however, failed to produce any rise in strength as the test proceeded. This effect is probably partly due to the fact that as part of the clay is decomposed by heating the effective water : clay ratio will increase during the test. This, however, cannot be the complete explanation and further work would be necessary to clear up this point. An important point is that, as shown by the curves, the dry-strength in general undergoes less deterioration during the test than does the green-strength. The latter is, therefore, more likely to be the limiting factor in determining the "life" of clays.

Comments on Results

Conditions during the laboratory "life" test used in the present work differ from those pertaining in the foundry, in that no part of the sand is subjected to a temperature in excess of 820 deg. C. Since, however, all bentonites lose their bonding properties when heated above 600 to 700 deg. C., in practice substantially all moulding properties of the sand will be destroyed in a layer adjacent to the mould/metal interface no matter what bentonite is used. The absence in the test material of a layer representative of the mould-face material should not, therefore, invalidate the test as a method of assessing life on a *relative* basis. Definite proof of this would, however, be desirable and would be most readily obtained from comparisons between test results and performance in service.

In so far as green-strength can be considered to provide an index of "life," it would appear that the latter is determined mainly by the dehydration characteristics of the clay, and that an assessment could be made in the case of bentonites from such indirect tests as differential thermal analysis, moisture-loss characteristics or the variation of base-exchange capacity with temperature. There are indications that montmorillonites of the 5 : 2 type are superior in "life" to montmorillonites in which replacement of Si^{4+} by Al^{3+} or Al^{3+} by Fe^{3+} has occurred, but this requires further substantiation.

Acknowledgments

The Authors have pleasure in acknowledging the financial assistance to meet the most of the work and the provision of a research bursary to one of them* initially by the British Iron and Steel Research Association and later by the British Steel Founders' Association (now the British Steel Castings Research Association). They also acknowledge the very willing assistance of S. Judge, P. Williams and J. Goodison in carrying out the numerous tests and chemical analyses required, and in the preparation of the manuscript.

APPENDIX A

Vapour Pressures of Saturated Salt Solutions at 30 deg. C.

	Mercury, mm.		Mercury, mm.
Water	31.82	Cobalt chloride ..	19.69
Potassium sulphate ..	30.85	Nickel chloride ..	16.25
Potassium nitrate ..	29.30	Magnesium chloride ..	10.01
Sodium chloride ..	24.02	Lithium chloride ..	4.14

* S. Davison

APPENDIX B

B.E.T. and Hüttig Adsorption Equations

According to the B.E.T. postulate, at any stage of adsorption, layers of 1, 2, 3, etc. molecular thickness are present in addition to uncovered surface. Equilibrium is reached when the rate of condensation to form any of these layers is equal to the rate at which its area is being diminished by evaporation from it to form a thin layer and condensation on it to form a thicker layer. By making certain assumptions, these investigators were able to arrive at an expression linking v the volume adsorbed with p the gas pressure. This is conveniently written:—

$$\frac{p}{v(p_o - p)} = \frac{1}{v_m c} + \frac{c-1}{v_m c} \times \frac{p}{p_o}$$

where v is the volume of liquid adsorbed at vapour pressure p, v_m is the volume of liquid required to form a complete mono-layer, p_o is the saturated vapour pressure over the plane surface of pure water and c is a temperature-dependent constant, the value of which is related to the heat of adsorption of the vapour on its surface and the heat of condensation to form the free-liquid phase. By plotting $\frac{p}{v(p_o - p)}$ against $\frac{p}{p_o}$, a straight line should be obtained, the slope of which will give $\frac{c-1}{v_m c}$, while its intercept on producing to $\frac{p}{p_o} = 0$ will give $\frac{1}{v_m c}$. Hence v_m and c can be evaluated separately.

Hüttig makes similar assumptions regarding the equilibrium condition, but assumes that molecules of the liquid covered by overlying layers can contribute equally with uncovered molecules to the evaporation loss. This leads to the expression:—

$$\frac{p}{v}\left(1 + \frac{p}{p_o}\right) = \frac{p_o}{c\,v_m} + \frac{p}{v_m}$$

In this case the plot of the expression on the left-hand side against p should give a straight-line of slope $\frac{1}{v_m}$ from which v_m and hence c can be evaluated.

The vapour-pressure isotherms for Pembina bentonite plotted according to the B.E.T. and Hüttig methods are shown in Figs. 17 and 18. It will be seen that the Hüttig equation fits the results the better of the two at high-moisture contents, and over a wider range, but gives a rather poorer fit than the B.E.T. equation at low-moisture contents.

REFERENCE

[31] C. F. Hüttig, *Monatsch.*, 1948, 78, 177.
[32] S. G. Henderson, B.I.S.R.A. Report No. SC/C/37/46.

Award on Pollution Claim. Finding that Dixon's Ironworks, Limited, Glasgow, were negligent in allowing tarry matter to enter and damage the Glasgow sewage system, Lord Hill Watson, in the Court of Session on May 13 awarded Glasgow Corporation £27,000 damages against the company, from whom they had claimed £28,887.

Publications Received

Heat-treatment of Aluminium Alloys. Published by the Northern Aluminium Company, Limited, Banbury, Oxfordshire.

This is the second edition of a booklet published in 1948, which was commented upon favourably in this JOURNAL at the time. The book, in a very interesting manner, first explains the mechanism of solution treatment and, then, precipitation heat-treatment and annealing are clearly explained. Following these considerations, the practice of heat-treatment is described in all its aspects in 19 well-illustrated pages. Tables for the heat-treatment of castings are included, though obviously, these are not so extensive as those covering the wrought product.

Opportunity for a Planned Career. Published by Vickers Armstrong Limited, Vickers House, Broadway, Westminster, London, S.W.1.

The title of this excellent brochure designed to tell boys in plain language of the training facilities offered by this great industrial organization means exactly what it says. This is stressed because it is feared some might read into it a royal road to success in life. This firm has unquestionably given much thought to the proper training of apprentices and has evolved not merely a workable scheme but a really satisfactory one—complete with classroom work, opportunity for scholarships to technical colleges and universities and, finally, "every assistance will be provided in helping you to make it a success." Surely no industrial organization can do more.

Notes on Machining the Nimonic Series of Alloys. Published by Henry Wiggin & Company, Limited, Thames House, Millbank, London, S.W.1.

A new edition of this useful publication has just been issued, containing additional information on drilling and extended to cover the newer alloys, Nimonic 90 and 95. This publication provides general guidance based on practical experience and makes reference to various tools and cutting oils which have been proved successful. Suggested speeds and feeds are given for each operation, together with diagrams of profiles and tool forms taken from actual machining operations. In general, essential requirements for the successful machining are (*a*) the use of tools which are sharp and will resist abrasion (*b*) slow speeds and a smooth drive with ample power to prevent stalling.

Year Book, 1953. Published by the British Standards Institution, 24, Victoria Street, London, S.W.1. Price 2s. 6d.

This book gives a list of the 2,000 British Standards current at the end of March, 1953, with a brief description of the subject matter of each. A comprehensive index simplifies reference. The Year Book gives the usual information on the membership of the General Council, the Divisional Councils and the Industry Standards Committees, together with the names of the representatives on the main Special Committees and Advisory Committees. For the first time the Year Book gives a list of the British Standards under which the Institution's certification trade marks are used, whilst particulars of the work in hand of all the Industry Standards Committees are also given. The Year Book is essential to all those engaged in industry and commerce if they are to keep up-to-date with the increasing momentum of practical standardization and simplification.

Personal

DR. JAMES T. MACKENZIE, Hon.M.I.Brit.F., has been presented by the American Society for Testing Materials with its Award of Merit in recognition of his distinguished service to that organization.

MR. JOSEPH O'HAGAN has taken up his new duties as general secretary of the National Union of Blastfurnacemen at its headquarters in Middlesbrough. He was formerly secretary of the western district of the union.

THE BRITISH TYRE & RUBBER COMPANY, LIMITED, announce the appointment at their Leyland factory of MR. W. BOWDEN as Group chemist, MR. W. GLOVER succeeding him as works chemist, and MR. C. H. HOLYOAK as Group works accountant. MR. H. ACKERS becomes deputy works superintendent.

SUPT. WALTER PARSONS, now in charge of police administration at Steelhouse Lane, Birmingham, police headquarters, is to leave the Birmingham City Police at the end of August to take up the post of works police chief at the Austin Motor Company, Longbridge. He will succeed Mr. James Dunnicliffe who is retiring under the age limit.

MR. S. C. MASSARI has resigned his position as technical director of the American Foundrymen's Society to become general manager, foundry division, Hansell-Elcock Company of Chicago. His position has been taken over *pro tem* by MR. H. J. HEINE. Mr. H. J. Wheelock is now managing editor of the Society's house organ and Mr. G. J. Minogne production manager.

MR. WALTER F. HIGGS, founder and chairman of Higgs Motors, Limited, is to leave in the early autumn for a long business trip, the object of which is to appraise the extent and effect of the re-entry of Japanese goods into world markets. He expects to be away about three months, and will go by sea to Bombay, and from there by air to Colombo, Singapore, Hongkong, and Tokio.

A PROUD RECORD is achieved by MR. WILLIAM BARNSLEY, head of the Bilston brass-founding firm of William Barnsley, Limited, who, at the age of 87, this month celebrates his 75th active year in industry. He claims to have had no more than three days illness in his life. A Coseley man, Mr. Barnsley left school when he was 12 to work as a boiler riveter's mate. He founded the present works of William Barnsley, Limited, 63 years ago. He still goes daily to the Bradley works. When his business began, he worked with two brothers in a shed in Albert Street, Prince's End, and then he bought an old foundry at Daisy Bank. The three brothers installed machinery and opened as the Globe Foundry, producing types of brass stamps. Nowadays, says Mr. Barnsley, the firm makes anything from bedstead fittings to parts for the Comet. The firm, William Barnsley, Limited, has other foundries in Bilston and Willenhall and is a family concern. Co-directors with Mr. William Barnsley are his brother Alfred, aged 74 and his son Clifford who is managing director and secretary. Three nephews work at the Globe and many of the workpeople have been with the firm for over 40 years.

MR. C. J. LAKE, joint managing director of Lake & Elliot Limited, has joined the board of Bowmaker Limited, Bowmaker (Plant) Limited being one of the subsidaries of the parent company, Bowmaker Limited, and not the parent company as was wrongly printed in our issue of August 6. We apologise for the error.

Japanese Iron and Steel Output

Provisional figures for June output and revised figures for May issued by the Japanese Ministry of International Trade and Industry show a rise in pig-iron production, which is a post-war record at 376,982 metric tons, compared with 369,015 tons in May. Ferro-alloy production is lower at 16,340 tons, compared with 16,587 tons in the previous month.

Crude steel output also fell from 651,270 tons in May to 639,838 tons in June. Hot-rolled products totalled 424,916 tons in June and 449,830 tons in May; castings 10,693 tons, against 10,865 tons; forgings 14,579 tons against 15,392 tons.

Tinplate output rose from 10,284 tons to 11,522 tons, galvanized iron sheets from 40,471 tons to 40,674 tons, but seamless steel tube production dropped from 20,379 tons in May to 19,516 tons in June.

Japan is suffering from an acute scrap shortage, due to the decline of supplies from South East Asia and the refusal of scrap merchants to sell at the prices offered by the steel industry. A scrap import agreement has been signed by nine Japanese steel producers fixing the maximum prices to be paid for scrap. These prices are c.i.f. India and Indonesia $55, Australia $54, Canada $53, Burma, Thailand, Indo-China, Hong-Kong, Okinawa, and the Pacific Islands $50, but the price for U.S. scrap has not yet been fixed.

Supervision of State Industries

A special committee of MPs, which has investigated Parliamentary supervision of nationalized industries, has recommended the appointment of a permanent committee of the House of Commons with power to examine the reports, accounts, and activities of State concerns. The report of the Select Committee on Nationalized Industries, published on Wednesday, suggests that the proposed committee should consist of not more than 21 members nominated annually. The committee should not aim at controlling the work of the corporations, and annual accounts would continue to be audited by auditors appointed by the Ministers concerned. The Select Committee arrived at its conclusions on the ground of the inadequacy of the existing facilities for Parliamentary supervision of State-controlled industries.

The witnesses included Sir Geoffrey Heyworth, chairman of Unilever, Limited, who is a part-time member of the National Coal Board.

Casting Plaster

A letter received from Foundry Services, Limited, of Long Acre, Nechells, Birmingham, 7, referring to a statement made by Mr. D. H. Potts at a meeting held in London, and reported in the JOURNAL, July 16, p. 82, points out that after much experimenting, this Birmingham firm has developed and for some time has been marketing a casting plaster, known as Pattrit "60." Mr. Potts had stated that, so far as he was aware, there was only one source in this country of plaster suitable for the purpose and, with the permission of the chairman, had named a firm in Market Harborough.

A TRADE AGREEMENT between Italy and Pakistan provides for Italian exports of iron and steel products and machinery and Pakistani exports of chrome in the year ending June 30, 1954.

DURAX

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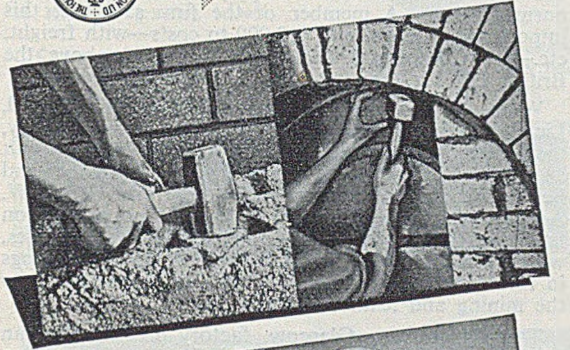

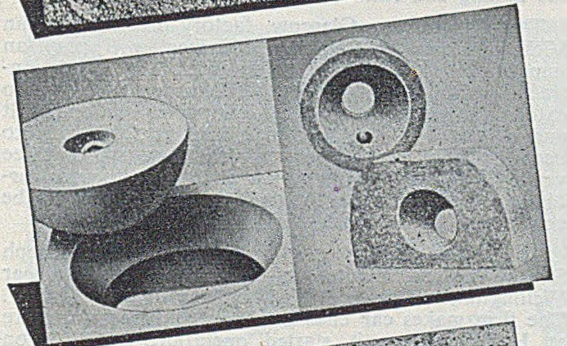

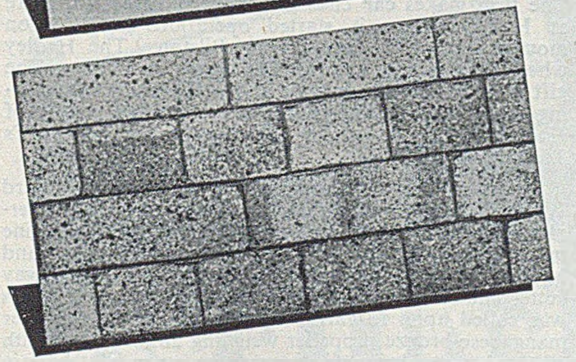

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News in Brief

NORTHERN ALUMINIUM COMPANY, LIMITED, announce that from August 24, 1953, the address of their Newcastle Area Sales Office will be Groat House, Collingwood Street, Newcastle-upon-Tyne, 1. Telephone: Newcastle 20878/9.

THE STARS AND STRIPES flew over the Austin Works, at Longbridge, Birmingham, on August 13 when a party of American servicemen was being shown round. The visitors travelled by Dakota to Castle Bromwich from their base in Essex.

SUFFOLK IRON FOUNDRY (1920), LIMITED, Stowmarket, are making arrangements to have the instrument for measuring the depth of the charge within the cupola, designed by their metallurgist, Mr. R. I. Taylor, manufactured for general sale.

THE BRITISH STANDARDS INSTITUTION, 2, Park Street, London, W.1, has issued a further standard in the series covering mild-steel drums. It deals with heavy- and light-duty full open-top drums with removable heads. (B.S. 2003: 1953), price 3s.

KOWLOON BUS COMPANY, of Hongkong, have ordered 20 double deck chassis from the Transport Vehicles (Daimler), Limited, Coventry, while Rotherham Corporation Transport Department have ordered 10 double deck bus chassis from the same firm.

THE BRITISH STANDARDS INSTITUTION, 2, Park Street, London, W.1, has recently issued recommendations for certain of the dimensional features of industrial measuring and control instruments and of the panels in which they are mounted (B.S. 1986:1953), price 3s.

RENTON & FISHER, steel founders, Hopetoun Works, Bathgate, are to extend and alter their existing office buildings, by the erection of a single-storey building to provide a board room, secretary's room, strong room, print room and additional sanitary accommodation.

WHITEHEAD INDUSTRIAL TRUST announce that in connection with the underwriting of last week's placing of 2,500,000 1s. ordinary shares at 1s. 1½d. each in Wilmer Lea Foundries (Holdings), the placing has been fully subscribed. Underwriters are, therefore, relieved of their commitments.

THE FOURTH ANNUAL SUMMER SCHOOL of Production Engineering is to be held at Ashorne Hill, near Leamington Spa, Warwickshire, from Wednesday, August 26 to Sunday, August 30. Details are obtainable from The Institution of Production Engineers, 36, Portman Square, London, W.1.

NEW DUNDEE BUSINESS.—By the end of this year Ferranti, Limited, electrical and general engineers, will employ about 150 people in the Dundee Industrial Estate factory which is being taken over from B.X. Plastics, Limited. The labour force is expected to grow eventually to about 350.

TO COMMEMORATE the centenary of the opening of Doncaster plant works, it is announced that the locomotive and carriage works will be open to the public on September 19 and 20, and on September 24, when the wagon works will also be open. A centenary service will be held and in addition famous locomotives will be on display.

JENOLITE, LIMITED, 43, Piazza Chambers, Covent Garden, London, W.C.2, have recently added a new preparation to their range of chemical degreasants. It is an emulsion-type degreaser, which may be used in the concentrated form supplied or in warm water dilutions up to 1:1 to meet individual requirements. It is non-inflammable.

ORDERS BOOKED by Charles Roberts, the wagon builders, amount to £6,750,000, nearly double the figure of a year ago. Revealing this in his annual review, Mr. Duncan Bailey, the chairman, also discloses that turnover in the year to March 31 was more than £2 million. The rate of turnover seems likely to expand if, as Mr. Bailey forecasts, supplies of steel become easier.

AFTER BEING CLOSED for two years, Wick foundry, an old-established business, will be reopened this week. The official opening, however, will be by Mr. Tom Johnston, chairman of the North of Scotland Hydro-Electric Board. The foundry has been taken over by Mr. J. M. Rollo, founder and chairman of the Highland Voluntary Development Association, and managing director of Dempster, Moore & Company (Machinery), Limited, Bonnybridge.

MORE STEEL IMPORTED.—First it was coal that Britain had to import from the Continent—now it is steel. James Howden & Company, Limited, Glasgow engineering firm, found that, to fulfil their commitments, they would have to get 1,300 tons of steel from somewhere—two months' supply according to their normal needs. A member of the firm said that this import added more than £10,000 to costs—with freight, etc.—for Continental steel costs some £8 above the British £37 15s. per ton.

WHEN 120 EMPLOYEES of Chamberlin & Hill, Limited, Lichfield Works, returned from their annual holiday, they moved into a new foundry which has been built at a cost of £110,000. It was begun last September and lies behind the old foundry in Beacon Street. Mr. P. W. Adshead, managing director, states that no production has been lost in the changeover to the new premises, which are among the most modern foundry buildings in the Midlands, designed to supply products mainly to the mining and textile industries.

THE GERMISTON, Glasgow, factory of Metropolitan Vickers Electrical Company, Limited, will play an important part in helping to fulfil the £3,500,000 contract received from Turkey. The order, which is to extend the capacity of Catalagzi power station, built and equipped by the firm after the war, will help to keep the local workers busy for the next two or three years. They will manufacture auxiliaries for the turbines which, along with the generators, are to be constructed at the main works in Manchester.

TO CELEBRATE ITS CENTENARY next year, Joseph Sankey & Sons, Limited, of Bilston and Hadley near Wellington, is to give £10,000 to the village of Hadley. The firm makes car chassis wheels and steel furniture at Hadley, where it started operations in 1910, on moving part of the works from Bilston. The Hadley wheel shop is now amongst the largest in Europe. The gift is to be used to provide and equip children's playing fields and recreation facilities for the people of Hadley, many of whom are among the company's 3,500 workers.

SELSON MACHINE TOOL COMPANY, LIMITED, at Cunard Works, Chase Road, London, N.W.10, have considerably extended their showroom. An interesting machine manufactured by one of their American principals and handled by the company recently was a Morton keyway cutter and slotting machine having a 72-in. stroke. This was called upon to cut a keyway in a 22-in. diameter manganese-bronze propeller weighing 28 tons, the width of the keyway being 5¼ in. and the range of the bore 4 ft. 6 in. When in position, the propeller dwarfed the machine; nevertheless, no difficulties were encountered and the key-seating operation was completed normally.

Raw Material Markets

Iron and Steel

Apart from the narrow margins of their fuel reserves, blast-furnace owners have few worries nowadays. They are well supplied with iron ore, both from home and oversea sources, and outputs of pig-iron are promptly absorbed. There may be small surpluses of No. 3 iron here and there, but an autumn revival in the demand for iron castings, which is hopefully expected, would speedily restore the balance. Hematite and, to a lesser extent, low- and medium-phosphorus grades, are definitely scarce, and plans for the further expansion of basic-iron production indicate that the needs of the open-hearth steel plants have not yet been overtaken.

The re-rolling industry is not operating to full capacity. The recent cut in export prices was an obvious bid to attract oversea buyers' interest in merchant bars, small sections, hoops and strip, but the immediate response has been disappointing. Perhaps there will be more favourable reactions in the autumn, but in the meantime business is very quiet and offerings of home-produced steel semis and of imported material exceed requirements.

In the finished steel trade, no new features have emerged. The shortage of steel plates persists, and although the difficulties of the shipbuilders have been most publicized, other users, such as engineers, boiler-makers, and tank builders, are similarly embarrassed. Sheetmakers are beginning to find that the home demand is insufficient to absorb the whole of their output, and, but for the fortuitously heavy demand from the United States and Canada, they might have been in need of orders. Heavy section mills have substantial bookings for the popular sizes, and railway and colliery equipment is extensively specified.

Non-ferrous Metals

The British Bureau of Non-ferrous Metal Statistics has issued figures in respect of June which do not reveal any special change in the situation from a month earlier. In copper, consumption was again low, the total for the month being 32,366 tons, of which 15,416 tons comprised virgin metal, the balance being scrap. In May the corresponding figures were 32,889 tons and 14,779 tons. Stocks again increased, but by only about 3,500 tons, the figure at June 30 being 185,946 tons, of which less than 11,000 tons was held by the consumers. Rather more than 25,000 tons was shown as afloat and held abroad, this tonnage, of course, belonging to the Government. Stocks of zinc at June 30 were 31,661 tons, against 34,078 tons a month earlier, while consumption of virgin and secondary metal amounted to 21,141 tons, compared with 20,105 tons in May. For the half year, consumption is about 15,000 tons below the figure in the corresponding period last year. The usage of lead in this country continues at a satisfactory rate and amounted in June to 23,612 tons, of which about 6,120 tons was represented by scrap and remelted metal. In May the corresponding figures were 24,350 tons and 6,500 tons. Consumption of tin in June was 1,519 tons, against 1,351 tons in May.

Last week saw a marked improvement in the value of tin, which moved up quite sharply. Little change was seen in either lead or zinc, although zinc failed to hold the highest points reached during the week's trading. Copper showed considerable strength. Undoubtedly much of the firmness in copper must be ascribed to fears of a strike on the copperbelt in Northern Rhodesia, where all the mines seem to be involved. An announcement from the Chilean Board of Trade gives permission to the smaller mines to dispose of their copper balances held abroad on the basis of the E. & M.J. quotation.

Official metal prices were as follow:—

COPPER, Standard.—*Cash*: August 13, £230 to £232 10s.; August 14, £232 10s. to £235; August 17, £230 to £232 10s.; August 18, £230 to £235; August 19, £230 to £235.

Three Months: August 13, £210 to £211; August 14, £214 to £215; August 17, £215 to £216; August 18, £218 to £218 10s.; August 19, £215 to £215 10s.

TIN, Standard.—*Cash*: August 13, £592 10s. to £595; August 14, £600 to £605; August 17, £610 to £615; August 18, £616 to £618; August 19, £617 10s. to £622 10s.

Three Months: August 13, £590 to £592 10s.; August 14, £600 to £602 10s.; August 17, £610 to £612 10s.; August 18, £612 10s. to £615; August 19, £612 10s. to £615.

ZINC.—*August*: August 13, £74 to £74 2s. 6d.; August 14, £73 12s. 6d. to £73 17s. 6d.; August 17, £72 to £72 10s.; August 18, £73 to £73 5s.; August 19, £72 10s. to £72 12s. 6d.

November: August 13, £74 to £74 2s. 6d.; August 14, £73 12s. 6d. to £73 17s. 6d.; August 17, £72 to £72 5s.; August 18, £72 15s. to £73; August 19, £72 10s. to £72 12s. 6d.

LEAD.—*August*: August 13, £95 15s. to £96; August 14, £95 15s. to £96; August 17, £95 5s. to £95 15s.; August 18, £95 15s. to £96; August 19, £95 5s. to £95 10s.

November: August 13, £89 15s. to £90; August 14, £89 15s. to £90; August 17, £88 15s. to £89; August 18, £89 5s. to £89 10s.; August 19, £89 to £89 5s.

Exports for China

Export licences covering about £3,500,000 for British goods for China have already been granted by the Board of Trade. It will be recalled that a group of British business men visited China in June unofficially, under the auspices of the British Council for the Promotion of International Trade, and signed a trade pact with China's national and export corporation worth about £15,000,000 in each direction. As a recent Press conference, Mr. Roland Berger, who presided, said that contracts for another £3,500,000 were signed in Peking, for which licensing authority is being sought.

Light engineering products, such as small hoists, figure among the orders placed which have been licensed, as well as scientific instruments. Other items are provisional upon the granting of the requisite B.O.T. licences. They include electric cables, generators, electric motors, switchgear, small tools, lathes, cranes, and metals. In a statement the group confirms that it is well satisfied with the outcome of its visit and is convinced that there is a substantial market for many kinds of British manufactures in China.

In the House of Commons recently the President of the Board of Trade made it clear that pending a reconsideration of policy at the appropriate time after the Korea armistice, Britain's policy on trade with China would remain unchanged.

A topical business announcement is made by Newman Industries, Limited, Yate, Bristol, as they have used a folder in the form of a cricket bat, carrying the caption The Final Test. The score card—like all score cards—is quite informative as to the performance of the motors which the firm manufacture.

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

August 19, 1953

PIG-IRON

Foundry Iron.—No. 3 Iron, Class 2:—Middlesbrough, £13 18s.; Birmingham, £13 11s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £16 14s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £17 0s. 3d.

Scotch Iron.—No. 3 foundry, £16 11s., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £18 3s.; South Zone, £18 5s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £19 3s.; South Zone, £19 5s. 6d.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £16 12s.; Scotland (Scotch iron), £16 18s. 6d.; Sheffield, £17 13s.; Birmingham, £17 19s. 6d.; Wales (Welsh iron), £16 18s. 6d.

Basic Pig-iron.—£14 6s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered).

Ferro-silicon (6-ton lots).—40/55 per cent., £53 10s., basis 45 per cent. Si, scale 21s. 6d. per unit; 70/84 per cent., £82 10s., basis 75 per cent. Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. to 11s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204 to £210 per ton; 38/40 per cent., £235 to £265 per ton.

Ferro-tungsten.—80/85 per cent., 21s. 4d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 24s. 3d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60 per cent. Cr, scale 28s. 3d. per unit: 6/8 per cent. C, £80 17s., basis 60 per cent. Cr, scale 26s. 9d. per unit; max. 2 per cent.C, 2s.2d. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr; max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £262 to £275 per ton; 96/98 per cent., £280 to £295 per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 40s. to 70s. per lb., Nb + Ta.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—Basic: Soft, u.t., £25 12s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £26 2s. 6d.; hard (0.42 to 0.60 per cent. C), £28; silico-manganese, £33 16s. free-cutting, £28 16s. 6d. Siemens Martin Acid: Up to 0.25 per cent. C, £32 12s.; case-hardening, £33; silico-manganese, £34 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 16s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 16s.; acid, up to 0.25 per cent. C, £33.

Sheet and Tinplate Bars.—£25 11s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £30 6s. 6d.; boiler plates (N.-E. Coast), £31 14s.; floor plates (N.-E. Coast), £31 15s. 6d.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £28 9s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £32 4s. 6d.; flats, 5 in. wide and under, £32 4s. 6d.; hoop and strip, £32 19s. 6d.; black sheets, 17/20 g., £41 6s.; galvanized corrugated sheets, 24 g., £49 19s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £51 14s. 3d.; nickel-chrome, £73 3s. 6d.; nickel-chrome-molybdenum, £80 18s. 3d.

Tinplates.—57s. 9d. per basis box.

NON-FERROUS METALS

Copper.—Cash, £230 to £235; three months, £215 to £215 10s.; settlement, £235.

Tin.—Cash, £617 10s. to £622 10s.; three months, £612 10s. to £615; settlement, £620.

Zinc.—August, £72 10s. to £72 12s. 6d.; November, £72 10s. to £72 12s. 6d.

Refined Pig-lead.—August, £95 5s. to £95 10s.; November, £89 to £89 5s.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £101; rolled zinc (boiler plates), all English destinations, £98 15s.; zinc oxide (Red Seal), d/d buyers' premises, £90.

Other Metals.—Aluminium, ingots, £150; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £69 to £70 10s. (nom.); nickel, £483.

Brass.—Solid-drawn tubes, 22d. per lb.; rods, drawn, 31⅞d.; sheets to 10 w.g., 249s. per cwt.; wire, 29¾d.; rolled metal, 235s. 9d. per cwt.

Copper Tubes, etc.—Solid-drawn tubes, 27d. per lb.; wire, 264s. 3d. per cwt. basis; 20 s.w.g., 291s. 9d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £157 to £170; BS. 1400—LG3—1 (86/7/5/2), £170 to £190; BS. 1400—G1—1 (88/10/2), £252 to £285; Admiralty GM (88/10/2), virgin quality, £252 to £300 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £265 to £295; L.P.Bl, £215 to £240 per ton.

Phosphor Bronze.—Strip, 348s. 6d. per cwt.; sheets to 10 w.g., 370s. 3d. per cwt.; wire, 43½d. per lb.; rods, 38½d.; tubes, 36½d.; chill cast bars: solids 37½d., cored 37d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Rolled metal, 3in. to 9in. wide × .056, 3s. 0½d per lb.; round wire, 10g., in coils (10 per cent.), 3s. 5½d.; special quality turning rod, 10 per cent., ½in. dia., in straight lengths, 3s. 3½d. All prices are net.

Increases of Capital

T. W. PEARSON, LIMITED, steel manufacturers, etc., of Sheffield, increased by £92,701, in £1 ordinary shares, beyond the registered capital of £15,000.

FOSTER INSTRUMENT COMPANY, LIMITED, Letchworth (Herts), increased by £40,000, in 10s. ordinary shares, beyond the registered capital of £60,000.

RICHARD LLOYD, LIMITED, machine-tool manufacturers, engineers, etc., of Birmingham, increased by £125,000, in 5s. ordinary shares, beyond the registered capital of £225,000.

ARMSTRONG WHITWORTH & COMPANY (PNEUMATIC TOOLS), LIMITED, Gateshead, increased by £47,500, in £1 ordinary shares, beyond the registered capital of £75,500.

PETER BROTHERHOOD, LIMITED, engineers and ironfounders, of Peterborough, increased by £175,000, in 10s. ordinary shares, beyond the registered capital of £340,000.

N. C. ASHTON, LIMITED, non-ferrous metal manufacturers, merchants, etc., of Huddersfield, increased by £25,000, in £1 ordinary shares, beyond the registered capital of £20,000.

FERRANTI, LIMITED, electrical engineers, etc., of Hollinwood (Lancs), increased by £1,000,000, in £1 5½ per cent. 3rd cumulative preference shares, beyond the registered capital of £2,500,000.

J. FRASER (METALS), LIMITED, iron, steel and metal merchants, and metal refiners, of London, W.C.1, increased by £10,000, in £1 6 per cent. cumulative preference shares, beyond the registered capital of £1,000.

LAYCOCK ENGINEERING, LIMITED, Sheffield, increased by £100,000, in £1 ordinary shares, beyond the registered capital of £500,000. At April 15, 1953, Birfield Industries, Limited, held a majority of the issued shares.

ALLOY PRESSURE DIE PRODUCTS, LIMITED, Wolverhampton, increased by £99,000, in 37,500 6 per cent. non-cumulative preference, 11,500 ordinary and 50,000 unclassified shares of £1, beyond the registered capital of £1,000.

W. MARTIN WINN, LIMITED, bright steel, bolt and nut manufacturers, etc., of Darlaston (Staffs), increased by £40,000, in 5,000 ordinary and 35,000 cumulative redeemable preference shares of £1 each, beyond the registered capital of £100,000.

CEYLON HAS LIFTED THE BAN on the export of scrap iron, although the export controller has discretion to refuse an export licence, as the metal comes under the category of strategic materials.

Obituary

MR. CYRIL POPPLETON, a director of Crossley, Ellis & Company, Limited, rasp and file makers, of Sheffield, has died at the age of 55.

MR. STANLEY GARSON, for many years blast-furnace manager at the ironworks of Gjers, Mills & Company, Limited, Middlesbrough, died recently. He retired about 10 years ago.

MR. JOHNSTON MITCHELL, who died suddenly last week at the age of 70, had a remarkable record of service with the Carron Company. He started work as an apprentice moulder at the age of ten, and cast up his moulds in the company's Mungal Foundry only two days before he died.

MR. PERCIVAL CHARLES BLEAKMAN, director and general manager of Pneulec, Limited, one of the Birmid combine, died at his Birmingham home on August 5 at the age of 65. With Birmid Industries, Limited, for most of his career, Mr. Bleakman was formerly associated with the Birmingham Aluminium Casting (1903) Company, Limited, as works engineer. He took over the chief post at Pneulec, Limited, Smethwick, some 11 yrs. ago.

MR. J. BILTON, the distinguished precision engineer, has died at Beckenham, Kent. Born in Cambridge in 1882, he founded the firm of precision engineers which bears his name and was the inventor and manufacturer of the Microtest vee blocks which have a world-wide sale. Some years ago, Mr. Bilton cut a set of over 2,000 Egyptian hieroglyphics used in the production of the Egyptian Grammar by Sir Alan H. Gardiner and every matrix was engraved to mechanical perfection. Oxford, Cambridge, New York, Chicago, Vienna and Brussels Universities have type-castings from these matrics.

CLASSIFIED ADVERTISEMENTS

PREPAID RATES : Twenty words for 5s. (minimum charge) and 2d. per word thereafter. Box Numbers 2s. extra (including postage of replies).

Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, 49, Wellington Street, London, W.C.2. If received by first post Tuesday advertisements can normally be accommodated in the following Thursday's issue.

SITUATIONS WANTED

FIRST CLASS Loam and Jobbing Moulder desires change. 20 years' experience in all types of strickle work. Excellent reference.—Box 3703, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER requires change. Conversant with all aspects of modern production methods and techniques also rate fixing, estimating, pattern shop and plant engineering.—Box 3697, FOUNDRY TRADE JOURNAL.

PATTERNMAKER, age 39, first class experience; present position, Chief Patternmaker with textile firm in India. Returning U.K. first week in October, 1953, requires responsible position, pref. Representative position. — Box 3679, FOUNDRY TRADE JOURNAL.

TRAVELLER calling on Foundries and Engineers in the Midlands wishes to contact Foundry Requisites and Firebrick Manufacturers needing representation on commission basis.—Reply Box 3634, FOUNDRY TRADE JOURNAL.

FOUNDRY EXECUTIVE, non-ferrous foundries, M.I.B.F., extensive experience of large and small castings by hand and mass production in all alloys; accustomed to complete control of all departments, and of higher responsibility. Capable administrator.—Box 3692, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER and Assistant seek positions offering scope for initiative. Accustomed working together. Complete control. Cupolas, Metallurgy, High Duty Grey Irons, Non-ferrous. Technical, Practical Apprenticeship served. All types of castings up to 12 tons Jobbing Plate Semi-mechanised. Keen disciplinarians. Foundry control in foundry, not desk men. Get results or get out.—Box 3696, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER, 30 years' experience jobbing and repetition; used to full control sales, buying and production, desires change. Willing to take up shares.—Box 3691, FOUNDRY TRADE JOURNAL.

A GRADUATE IN METALLURGY, whose main interest is in foundry techniques and management, seeks a progressive position offering scope for hard work and initiative. Sound industrial experience. Age 28 years.—Box 3687, FOUNDRY TRADE JOURNAL.

FOUNDRY RESINS, CORE SHOP AND SHELL MOULDING. Representative, several years' practical experience technical and commercial, all branches foundry resins, United Kingdom and Continent, desires appointment in Sales/Technical Sales organisation of resin manufacturers. Excellent connections.—Box 3688, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order 1952.

GENERAL MANAGER required for Modern Mechanised Malleable Iron Foundry. Applicants must have excellent production and administrative ability, combined with good educational and technical background.—Apply in confidence to Box 3671, FOUNDRY TRADE JOURNAL.

METALLURGIST required for Midland Foundry producing High Duty Cast Iron and Aluminium Castings; experience of Cupola Control essential. Please write giving full details of experience, etc., to Box 3666, FOUNDRY TRADE JOURNAL.

FOUNDRYMAN to supervise machine moulding operations with special emphasis on quality control. Modern, up-to-date plant, with interesting range of work. State age, experience and salary required.—Box 3079, R. & W. ADVERTISING, 18, HANOVER STREET, EDINBURGH.

FOUNDRY producing Mechanite requires experienced Foreman Moulder. Jobbing, machine tool and engineering castings up to three tons. Disciplinarian, able to assess prices, etc. Southern area. Give full details age, experience and salary required.—Box 3682, FOUNDRY TRADE JOURNAL.

FOREMAN required to take charge of Iron Foundry in S.E. London area, engaged in the production of high class engineering and machine tool castings by hand moulding and machine moulding methods. Applicants should have first class experience in foundry practice and administration. Situation offered is a permanent one and possesses excellent prospects for right man. State age and full details of experience.—Box 3694, FOUNDRY TRADE JOURNAL.

APPLICATIONS are invited from foundry engineers, approximate age 30 to 35 years, prepared to accept a supervisory position on the staff of a company operating on the Continent, with headquarters in Paris. It is essential that the applicants have a good general education to engineering degree standards, with basic training in foundry practice, and with some metallurgical training. Direct grey iron foundry experience is essential. Full details of education and industrial experience should be addressed to Box 3690, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

DRAUGHTSMAN/ENGINEER. Opening offered by Ventilating Engineers in Birmingham area to experienced young Foundry Maintenance Draughtsman; some Dust Control experience desirable. Full details of experience, age, salary required, to Box 3698, FOUNDRY TRADE JOURNAL.

CASTINGS INSPECTOR, Light Grey Iron Foundry, Wolverhampton Area, first class man, able to read drawings, mark off and check. Knowledge of machine shop practice an advantage. Age, under 40. Please give previous experience.—Box 3702, FOUNDRY TRADE JOURNAL.

FOREMAN for Foundry within 20 miles London making high class engineering and jobbing castings with a personnel of about 70. State age and full particulars of training and experience.—Box 3704, FOUNDRY TRADE JOURNAL.

THE DAVID BROWN FOUNDRIES COMPANY, Penistone, Nr. Sheffield, require the services of two Research Metallurgists, one with metallographic experience and the other capable of carrying out Creep Testing under the direction of the Chief Research Metallurgist. Reply giving full details of age, qualifications and experience to Personnel Superintendent.

FOUNDRY MANAGER: Applications are invited from foundrymen who are capable of filling this position with a well organised grey iron foundry in Tipton. Applicants must be qualified metallurgists. The foundry, patternshops, etc., are modern and well equipped. Prospects are excellent, the job offers a good salary and is superannuated.—Write giving full details to Box 3695, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN required for Cast Iron Foundry. Average weekly output approximately 25 tons. Applicants must have first class practical knowledge of the industry, including Cupola practice, capable of estimating and fixing piece work prices and planning, and administrative ability. A permanent position to the right man, with Pension Scheme. State age, experience, salary required and when at liberty.—Apply Box 3699, FOUNDRY TRADE JOURNAL.

IRON AND STEEL FOUNDRY in the Midlands require the services of a Working Chargehand, with experience of modern methods of Core Blowing. Must be capable of deciding best methods of Core Box Construction, Venting, Blower Heads and Plates, Driers and generally to see to the successful operation of the Plant. Only Applicants considered are those with suitable previous experience. Apply in first instance, giving full particulars re age, salary, experience, etc., to LLOYDS (BURTON) LIMITED, Wellington Works, Burton-on-Trent.

SITUATIONS VACANT—*contd.*

METALLURGIST, young, required immediately by Derby Foundry. Thorough knowledge small Alloy Steel Castings essential. Apply giving details of qualifications, if any, experience, age, salary required and state earliest date available.—Box 3705, FOUNDRY TRADE JOURNAL.

FOREMAN required for Aluminium Pressure Die Foundry: fully experienced in the operation of Reed Prentice and Lester Machines. Reply stating experience and salary required to Box 3700, FOUNDRY TRADE JOURNAL.

INSPECTOR required for checking patterns and marking out magnesium castings. Must be able to work with minimum supervision. Applications stating experience and salary required to Secretary, MAGNESIUM ELEKTRON LIMITED, Clifton Junction, Nr. Manchester.

METALLURGIST wanted for Tyneside Jobbing Ironfoundry making High Duty Castings to specifications. Please state experience, salary required and when available.—Box 3701, FOUNDRY TRADE JOURNAL.

DIE DESIGN: Senior Draughtsman required; fully experienced on Gravity and Pressure Die design. Write giving full details of experience and salary to MARSHALL CASTINGS LTD., Mount Street, Birmingham, 7.

EXPERIENCED Pressure Diecasting Chargehand used to MK400, MK215 and E.M.B. machines.—MARSHALL CASTINGS, LTD., Mount Street, Birmingham, 7.

SALESMAN REQUIRED for Foundry producing Grey Iron Castings. Knowledge of foundry practice and experience in the sale of castings essential. Good prospects for suitable representative.—Apply EXELEIGH FOUNDRY LTD., Tiverton, Devon.

DRAUGHTSMAN required with General Engineering Experience, Estimating and Weight Calculating an advantage. Wages according to age and experience. Staff Pension Scheme. Applicants send full particulars to The Managing Director, GLANMOR FOUNDRY CO., LTD., Llanelly, Carms.

FOUNDRY FOREMAN, accustomed to supervising production of iron castings up to 3 tons, required by Iron Foundry in the Medway area. Applicants must have experience in the supervision of all branches of Iron manufacture, including Cupola practice. This is a permanent situation, with a Pension Scheme.—Apply Box 3654, FOUNDRY TRADE JOURNAL.

A FIRM, manufacturing Precision Aircraft Instruments in South Wales, requires young ASSISTANT METALLURGIST, Degree, L.I.M. or H.N.C. standard, preferably with some experience of physical testing, heat treatment, and metallographic examination of ferrous and non-ferrous alloys. Recent graduates with no experience considered; excellent prospects.—Apply Box 3655, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER required for Foundry in Wolverhampton area, producing Grey Iron and Non-ferrous Castings and with own Patternshop. Applicant must be first class, with sound practical experience, a good disciplinarian, and used to responsibility and exercising control. The post carries a good salary, with eventual entry into a Pension Scheme after a period of satisfactory service.—Applications, which will be treated as confidential, should be sent, along with full particulars, etc., to Box 3693, FOUNDRY TRADE JOURNAL.

FINANCIAL

SMALL Grey Iron Foundry, Stourbridge area, requires active Partner or association with larger Foundry, or would consider selling.—Box 3674, FOUNDRY TRADE JOURNAL.

AGENCY

WELL-ESTABLISHED London company, with West End office and sales staff, sole Representatives for well-known provincial ferrous foundry, will consider similar appointment for Die Casting Foundry with machine shop having London and Home Counties connections.—Box 3667, FOUNDRY TRADE JOURNAL.

PROPERTY WANTED

WANTED: Steel Foundry, situate Sheffield, North of England or Scotland. Area 10,000 sq. ft. equipped high frequency melting furnaces 10 cwts. capacity; willing consider purchase capital or controlling interest in established business.—Write giving details to Box 3621, FOUNDRY TRADE JOURNAL.

PROPERTY FOR SALE

FURNESS DISTRICT, small well built, two storey building for sale, suitable for small workshop or warehouse, at present small foundry.—Box 3622, FOUNDRY TRADE JOURNAL.

FOR SALE

SOUTH WALES. OLD ESTABLISHED NON-FERROUS FOUNDRY AND ENGINEERING WORKS AS A GOING CONCERN. BUILDINGS COVERING LARGE AREA EXCELLENT FACILITIES, CAPABLE LARGE OUTPUT. GROUND AVAILABLE FOR EXTENSIONS. ENQUIRIES INVITED. BOX 3604, F.T.J.

PATENT

THE Proprietor of British Patent No. 577682, entitled "Improvements in Furnace Construction," offers same for licence or otherwise to ensure practical working in Great Britain.—Inquiries to SINGER, STERN & CARLBERG, 14, East Jackson Boulevard, Chicago, 4, Illinois, U.S.A.

MACHINERY WANTED

WANTED, second hand 1 ton electric chain hoist block with hand geared travel.—Box 3681, FOUNDRY TRADE JOURNAL.

WANTED, 4,000 lb. Pneulec-Herman Jarr Rollover Pattern Draw Machine. State age, condition and price required to K. & L. STEELFOUNDERS & ENGINEERS, LTD., Letchworth, Herts.

WANTED, second hand Foundry Floor Type Plate Mould Conveyor.—Box 3683, FOUNDRY TRADE JOURNAL.

WANTED immediately, 75 to 100 lbs. capacity Rocking Arc Smelting Furnace, together with electrics suitable for 440-volt, 3-phase, 50-cycle supply.—Box 3684, FOUNDRY TRADE JOURNAL.

MACHINERY FOR SALE

ENSIGN Pedestal drilling machine; 1¼ in. capacity. Fully motorised, 400/3/50.—FRANK SALT & CO., LTD., Station Road, Blackheath, Birmingham.

1 SIZE No. 602, Osborn Stationary Roll-Over Jolter; 900 lbs. capacity at 80 lbs. per sq. in.; table length, 36 in.; box width, 26 in.; pattern draw, 11 in.; box depth, 15 in.; jolt cylinder, 6 in. dia.—Box 3677, FOUNDRY TRADE JOURNAL.

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1 TON MORRIS ELECTRIC HOIST on Carriage. Wire rope type. New condition. 400/3/50.

3 ton New "Coles" Electric Hoist block, including Geared travelling carriage.

5 ton Crane Grab; 2 Motor type; Brand new; Unused; 400/3/50. Suitable for floor pendant control.

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BMM. RD.5. JOLT SQUEEZE TURNOVER, cap. 1,300 lb., pattn. draw 12 in.; table 48 in. by 30 in.
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C/WALLWORK ON JOLT SQUEEZE PATTERN DRAW, cap. 600 lb., pattn. draw 10 in.; max. size boxes 20 in. sq. or 25 in. by 12 in.
C/WALLWORK WT562C JOLT SQUEEZE TURNOVER, cap. 800 lb., pattn. draw 10½ in.; table 35 in. by 24 in.
C/WALLWORK R.2 CORE BLOWER.
POLFORD MOULD DRYER, Coke Fired.
FORWARD FOUNDRY SAND RIDDLE, tripod type.
150/200 lb. ALUMINIUM BALE OUT FURNACE.
HALF TON CENTRAL AXIS TILTING FURNACE.
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AIR COMPRESSORS OF ALL TYPES IN STOCK, 2 c.f.m. to 3,000 c.f.m.

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1 CUMMING Jolt Table Moulding Machine. Size 20 in. by 30 in.

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4 ft. 0 in. Sand Mill. Underdriven. Motorised 400/3/50.

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NO. 16 ATRITOR CRUSHER by Alfred Herbert, complete with Feed Hopper, overhauled and with a quantity of spares. Also a No. 12 Atritor by Alfred Herbert, for which we have available about 6 tons of spares. Both these machines are offered at extremely low prices for quick clearance.

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5-TON OVERHEAD TRAVELLING GANTRY, motorised in three directions, 400 a.c., span 31 ft. 6 in.

300 cu. ft. Broom & Wade Vertical Air Compressor, Type EH.240, 100 lbs. working pressure.

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Metal Degreasing Plant by I.C.I., Gas Heated. Compartment size 36 in. by 24 in. by 24 in.

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250-C.F.M. vert., 2-stage, watercooled Air Compressor by Browett Lindley; 100 lb. pressure; "V" belt driven from a 65-h.p. slipring Motor, for 400/3/50; 1,450 r.p.m., with Control Gear.

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SAND MIXERS and DISINTEGRATORS for Foundry and Quarry; capacities from 10 cwts. to 10 tons per hr.—W. & A. E. BREALEY (MACHINERY), LTD., Misterton, nr. Doncaster. Tel.: Misterton 202.

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LANCASHIRE BOILER FLUES, suitable for Cupolas; can be inspected at our works; cheap.

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CAPACITY available for Light Castings weighing from 1 lb. to 5 cwts., including Castings for Vitreous Enamelling. WESTERN LIGHT CASTINGS FOUNDRIES, LTD., Fairwood Foundry, Gowerton, near Swansea, manufacturers of malleable iron castings.

FOUNDRY capacity available. For up to 5 cwts., machine moulded; for up to 2 tons, floor moulded. Prompt delivery. —LEWIS' FOUNDRY CO., LTD., Ammanford.

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CAPACITY available for castings weighing from 1 lb. to 15 tons, including Quasi-Bessermised ingot moulds up to 10,000 tons per annum.—THE CROSS FOUNDRY & ENGINEERING CO., LTD., Gorseinon, near Swansea.

MECHANISED FOUNDRY.—Malleable and Grey Iron Castings offers 20 tons per week free capacity at early date. Preference for boxes up to 28 in. by 16 in. by 5 in. by 5 in. Snap Flasks up to 14 in. by 14 in. by 3 in. by 3 in. Hand moulding capacity also available. Cast Iron Pipes flanged and specials. Patternmaking facilities if required.—E. J. WALLACE, 39, Constitution Street, Dundee.

CAPACITY AVAILABLE—*contd.*

NON—FERROUS FOUNDRY — First-class quality castings in Aluminium, Bronze, Gunmetals, etc., at competitive prices, including patterns if required.—BEESTON LEE & CO., LTD., 33, Swindon Road, Stratton St. Margaret, Wilts.

ARE you requiring immediate delivery of Non-Ferrous Castings? Can you get prototypes quickly? Can you get 24 hour Breakdown Service? We can give you all the above for large or small quantities in Sand or Die. Pattern-making and machining if required.—Write, 'phone or call ABERCORN BRASS FOUNDRY, Hilda Road, Canning Town, E.16. ALBert Dock 2420.

MISCELLANEOUS

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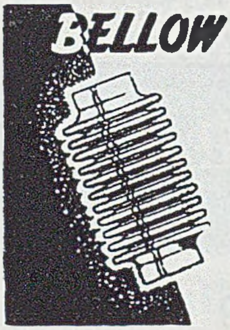

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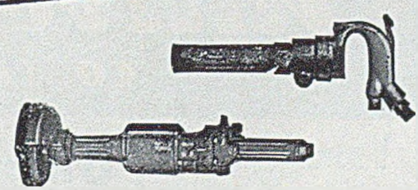

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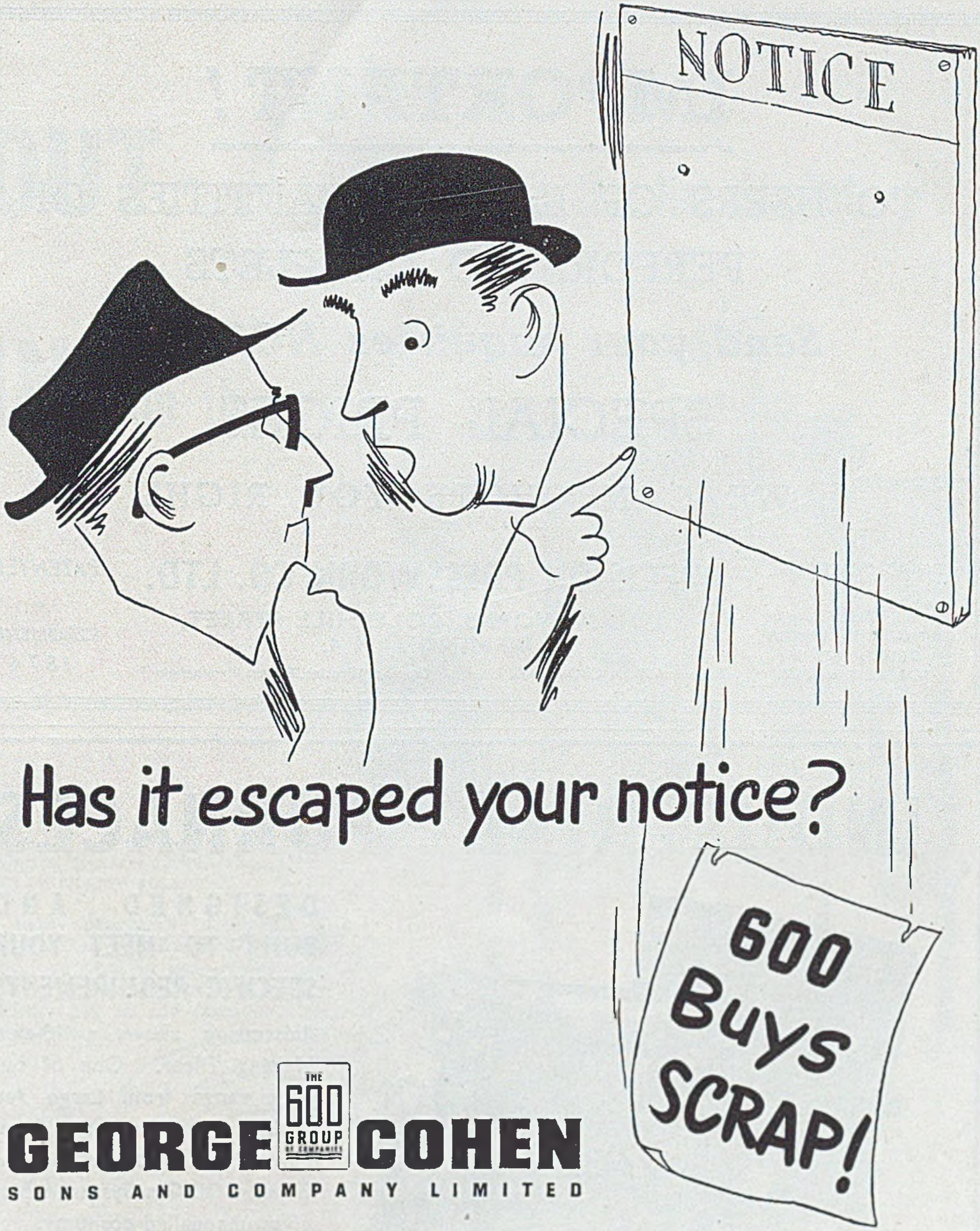
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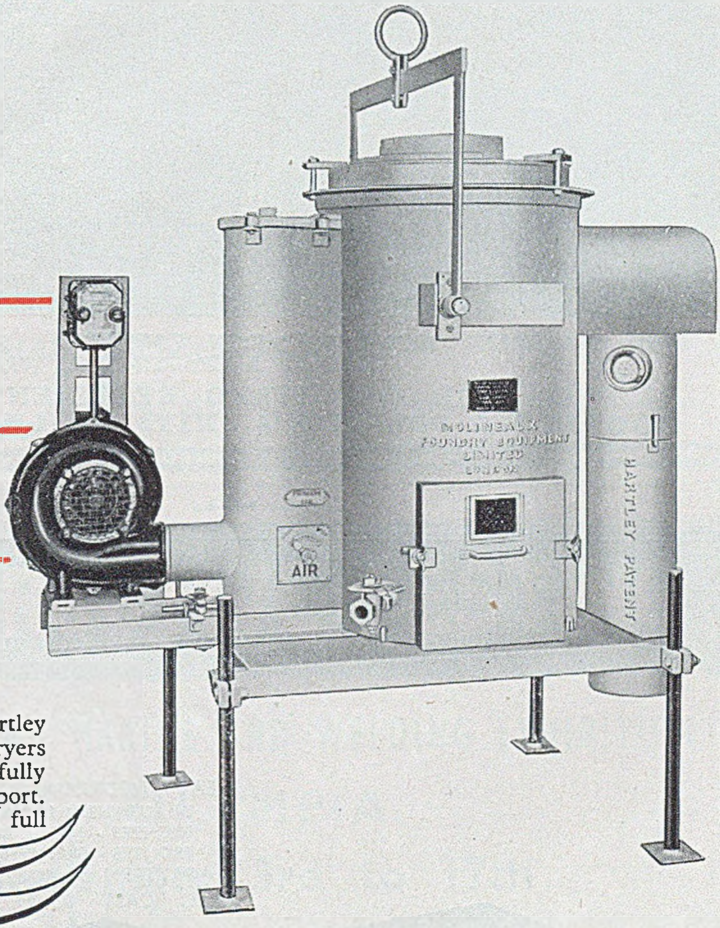

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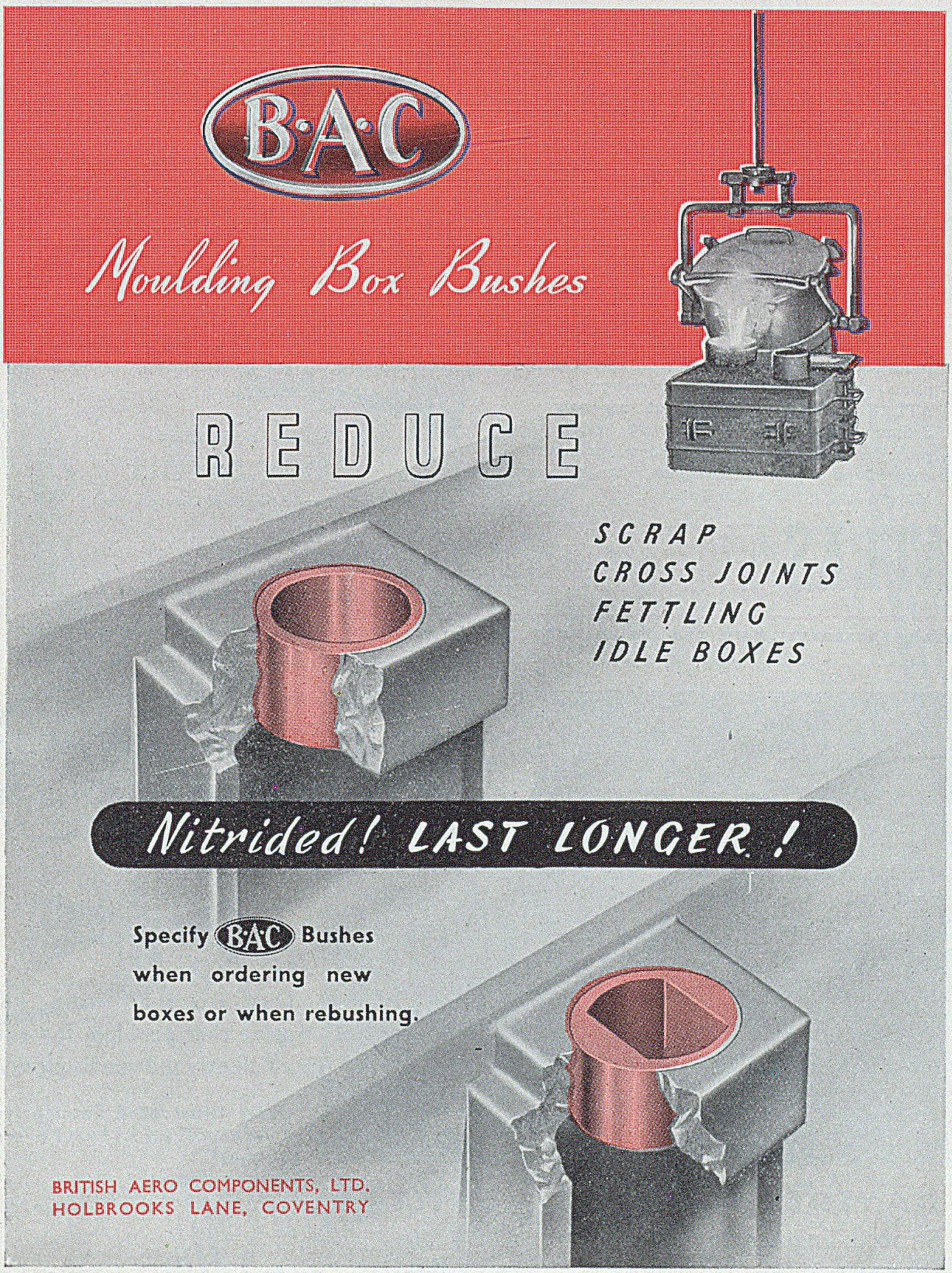
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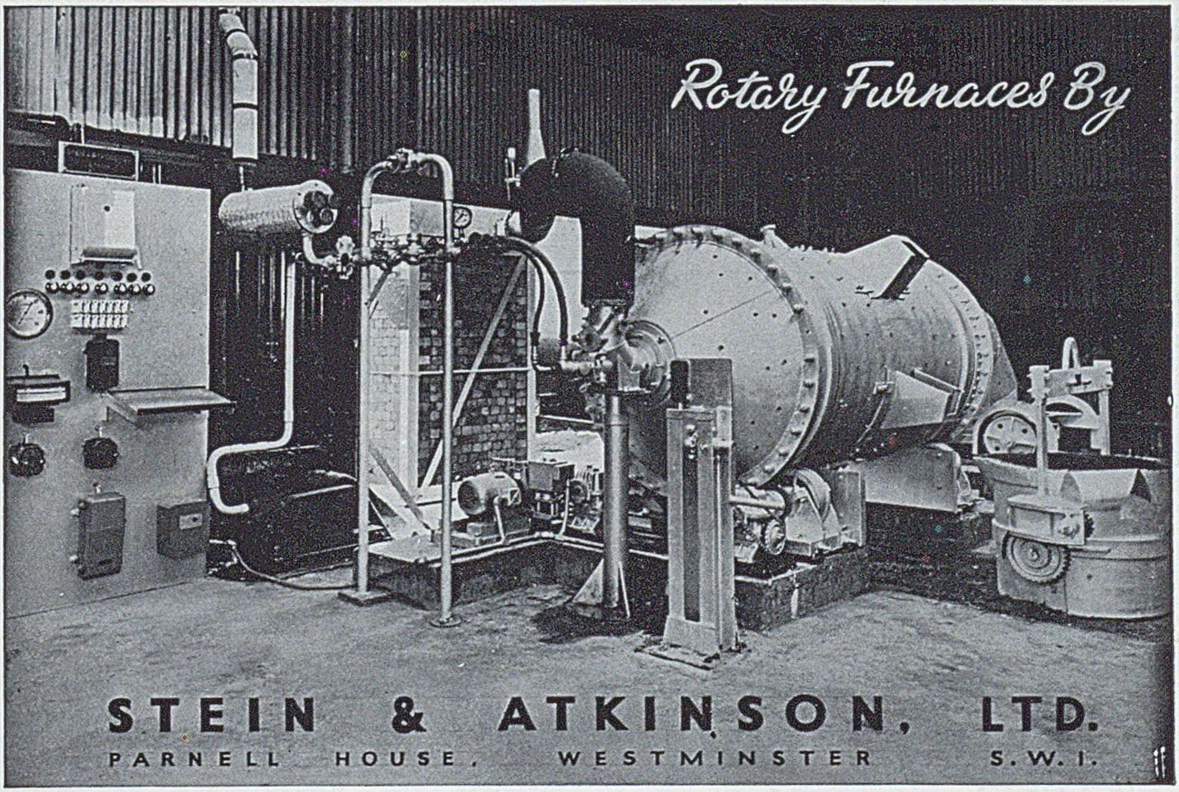
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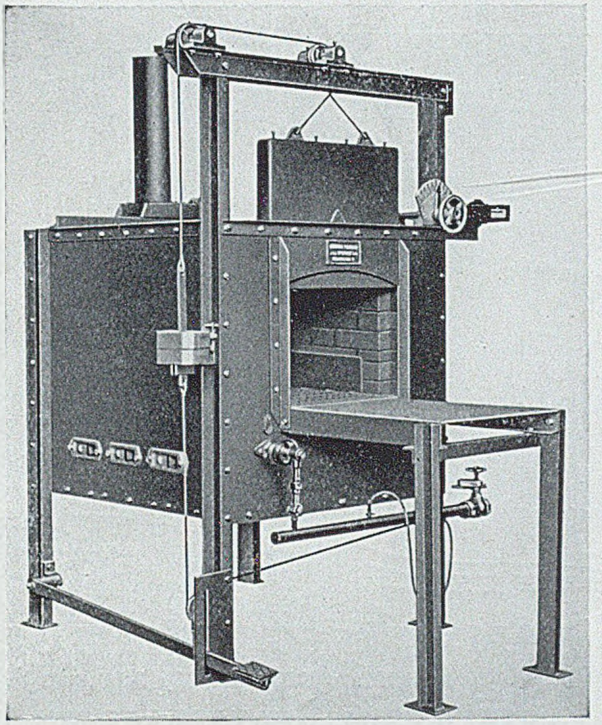

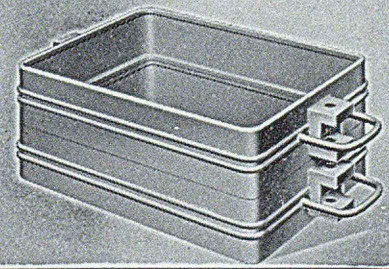

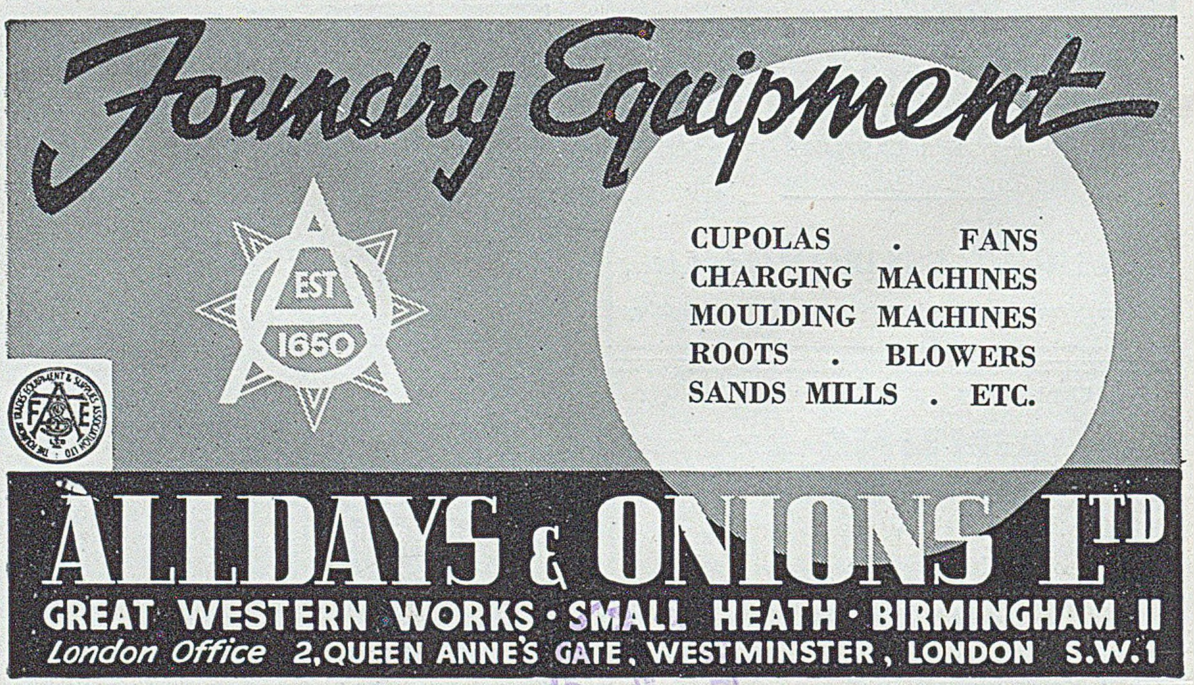

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