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Simplified Selling

For several years now there has been in existence "The Purchasing Officers' Association." We have followed with considerable interest the undoubted progress it has made and one of our representatives participated in its recent annual congress at Brighton. The existence of this body is of some significance for the foundry interests because it provides a means for co-operation for the improvement of cast products. In the past, a foundry salesman has had—in order to provide a satisfactory service—to establish such a friendly atmosphere that essential information was thereby (bit by bit) forthcoming. Obviously this should not be necessary and a standard questionnaire accepted by the Association and the foundry industry would supply *ab initio* the information now dragged out of the buyer by correspondence, telephone or personal calls.

When an order for castings is being negotiated, the foundry should immediately receive all possible information as to the pattern equipment. It is essential that if patterns are to be supplied the manufacturer of castings should be informed whether they are of metal or wood construction and how many castings have been made from them up to the present. It is justifiable to ask what major defects have shown up in the past and whether there are any special requirements. In one case which came to our notice, a modicum of malleability was required along one edge of a casting—a factor not discovered until the consignment was deemed unsatisfactory, but this could have been arranged for had the foundry manager but known. Purchasing officers may be hard-bitten, but they quickly learn that it seldom pays to buy on price alone. It is realised that they are really the agents of a number of departmental managers and the success of a buying department is a measure of the intelligent interpretation given to requisitions for plant and materials.

The American Foundrymen's Society have through their Cost Committee, evolved a standard form of enquiry for the supply of castings, which with slight modifications could easily be adopted for use in this country. The questions asked are of such a character that time must necessarily be saved. For instance, in connection with coreboxes, there is sought for each one the following information:—The number required for each casting; the material from which the box is to be made; the number of boxes; number of cores per box; designed for one blowing?; shell carriers—material and number? Finally there is a request for the total number of cores per casting. It may be that the purchasing officer will find a little difficulty in filling up the first one, but he will have learnt much about the job. Later ones will be almost routine. He will have learnt that patterns made for one type of metal may not answer for a second, for the contraction allowance has to be stated. The price he will receive will be for a casting or a batch, the weight of which he has to find out. Yet it is this common understanding between buyer and seller of the problems of production which is essential for intelligent co-operation. It will result in lowered prices and improved products.

Contents

Visit to Wilsons & Mathiesons, Limited

During the afternoon of the second day of the Conference of the Institute of Vitreous Enamellers, at Harrogate, a visit was paid by about 60 members to the enamelling shops and foundries of Wilsons & Mathiesons, Limited, of Leeds, travel being by coach. This firm is one of the Radiation group, specialising in the production of bath-tubs and gas cookers, both being vitreous enamelled at the home works.

On arrival, the visitors divided into parties, led by competent guides, and toured a large number of production departments. One party first witnessed the fabrication of a one-piece cooker oven by spot welding and followed this item through the enamelling section to its completion. The plant used included a continuous pickle and nickel-dip system by Electro-Chemical Engineering, Limited, where 8½-min. intervals were allowed in each tank. Here the clear labelling of the vats with their contents and concentration range was a noteworthy control feature. Next, dip ground-coating and continuous drying in a Ferro-Ballard installation was seen; an interesting innovation here being a high-pressure water-spray cabinet for intermittently cleaning the carriers. A "Ferro-Junior" continuous oven for firing ware was seen in this section. This utilised heavy fuel-oil and embodied automatic temperature control. Next examined were batteries of orthodox fork-lift-charged stationary-type furnaces. An interesting arrangement seen before leaving this section was a mechanical brush-off for the edges of ware, consisting of a gauge-controlled felt bob mounted in a pneumatically driven hand tool.

Passing through the "wet" and "dry" mill-rooms, the visitors were next shown the dry-dusting process for enamelling cast-iron bath-tubs. Much interest was displayed in the mechanical manipulator and the lever-lift trolley for handling the tubs (which were first given a wet ground-coat) in and out of the separate preheating and firing muffles. About 18 to 20 lb. is added to the weight of a tub during enamelling. A rotary-table shot-blast and a room-type plant, both by St. George's Engineers, were inspected. It takes one man 7 min. to clean and 20 min. to strip a bath-tub in this plant. On leaving this section, the route passed through the packing and despatch section, where the final products were much admired.

Mechanised Foundry

The visitors next passed to the mechanised foundries, where a very large output of the smaller type of cooker casting in particular was being obtained from two continuous casting loops. The cupolas here (two large and two small) were skip charged and molten metal was transported in short barrel-type ladles suspended from monorails. There were two continuous sand plants by Foundry Equipment, Limited, with a manually operated plough-off overhead to the machine hoppers. Several makes of moulding machines were in use, including a new rotary rail system employing six men for one half-mould.

The tour concluded with a rapid survey of the brass shop, where gas taps and miscellaneous fittings, including "Regulo's," are made. Finally, the visitors passed through the press shop *en route* to the canteen, where tea was served to the visitors. Thanks for the reception accorded and for the afternoon's tour were expressed to the management by Mr. C. P. Stone on behalf of the visitors.

Notes from the Branches

Middlesborough

On November 10, an interesting lecture was given to the Middlesbrough branch of the Institute of British Foundrymen by Mr. A. C. Brearley, of Letchworth, on "The Oxygen Blowing of Steel." This lecture was exceedingly well attended and 15 guests were present.

Mr. Brearley had visited the States and had seen something of the methods used there for the removal of carbon from steel. He described the many snags which had arisen in his works when the best method for removing carbon was being sought. Many months of hard and very often unfruitful work had been spent before a satisfactory solution of the problem had been found. He related how, despite the large sums of money expended on the preliminary work, his company had now been amply repaid by the great savings that were made in the production of low-carbon steel.

A very interesting discussion followed Mr. Brearley's absorbing lecture. Many questions were asked by members, some of whom had experienced many of the difficulties which Mr. Brearley described. The method described of checking the tapping temperature was one which interested several people. They wondered if this operation was difficult and if there was any danger from extra heat. Mr. Brearley replied that there was very little danger. In this connection, also, Mr. Johnson asked what Mr. Brearley thought of the extremely high tapping temperatures which seemed to be common practice in the U.S.A. Mr. Brearley replied that it was quite true that they did tap at temperatures much higher than was common in British foundries.

Members also displayed interest in the effects of oxygen blowing of 5 per cent. chrome and molybdenum steel and steels with high silicon content. The president said he thought that with a shorter refining period there was less trouble with hydrogen. Mr. Siddle inquired how the carbon content was checked. Mr. Brearley said a Carbometer was used which was correct to within about 0.03 per cent.

After the discussion Mr. Siddle proposed a vote of thanks to Mr. Brearley for the lecture, which had obviously aroused real interest.

Dinner

British Steel Founders' Association

Mr. Frank Rowe, B.SC., presided last Wednesday week, at Claridge's, on the occasion of the annual meeting of the Association. Amongst those present were:—Viscount Davidson, Sir Robert Sinclair, Mr. T. H. Summerson, Lt.-Col. Lord Dudley, Sir Alexander Ramsey, Vice-Admiral Sir Charles Barry, Mr. F. Pickworth, Mr. D. W. L. Menzies, Sir Ronald Garrett, Mr. J. L. Wheeler, Mr. A. Croft, Mr. A. C. Strathie, Mr. J. R. Menzies-Wilson, Mr. J. J. Sheehan, Mr. F. N. Lloyd, Mr. F. A. Martin, Mr. W. Lyons, Mr. R. A. Riddles, Sir Norman Kipping and Mr. C. R. Urquhart.

THE JOINT IRON COUNCIL have printed a report of the speeches made at the annual dinner held at the Connaught Rooms last September. Reading it brought back memories of a delightful evening, but it is felt that such speeches should be heard and not read.

Methods of Producing Nodular Cast Iron*

By R. Collette and Albert De Sy

SINCE THE PRODUCTION of spherulitic-graphite cast iron, about two years ago, there have been many Papers on the subject throughout the world, and several methods have been evolved for obtaining cast irons with graphite in the spherical form. To produce a nodular cast iron, which is a very complex alloy compositionally, is nowadays quite easy, but there are still some problems to be solved. The most economic, scientific and metallurgically rational means for success must be established.

Nodular-graphite cast iron has interesting properties, which can be mentally established by reference to Table I.

It is now known that nodular cast irons can be produced by means of one of the elements of the series Ce; Mg; Li; Ca; Sr, and Ba. The order is set out according to chronological discovery. Some results, without being quite a complete success, have been likewise obtained at Ghent, using potassium, sodium, boron and tellurium. Can it be said that, following one's own bent, one can use no matter which of these elements? Evidently not. To produce nodular iron, it is essential to force the spherulitic crystallisation of the graphite whilst avoiding as far as possible all other types of free carbon. To do this, it is necessary to incorporate in the iron suitable quantities (usually quite small amounts) of one of the elements indicated above. It has been laid down that this element should be (1) a powerful deoxidant; (2) to a certain extent a carbide stabiliser; (3) where solubility in the iron does not occur, the emulsion of the liquid or gaseous element should help to this end, and (4) it is possible that the element may be a desulphuriser, but this has not yet been definitely proved (powerful deoxidising elements are, as it happens, desulphurisers and *vice versa*.

The major difficulty lies precisely in the fact that these elements, being scarcely or not at all soluble in the iron, are not easy to incorporate. From this, as will be shown, it would appear that it would be desirable to know the boiling points of the elements which play the important part in the spherulitic crystallisation of the carbon. The low boiling point of magnesium (1,100 deg. C.) causes the vaporisation of this element during the treatment; that is to say, it is a cause of distinct difficulty when using this metal, yet in another direction shows an advantage which is turned to good account. Actually the magnesium vapour which escapes produces in the iron bath a true emulsion which purifies the metal throughout and permits of the removal of impurities (oxides, sulphides, etc.).

This advantage is not shown to the same extent by the other elements so far used, with the exception of potassium and sodium, the boiling points of which are 775 and 892 deg. C. respectively. Actually, the boiling points of these elements are: Li, 1,370; Sr, 1,380; Ce, 1,401; Ca, 1,440, and Ba, 1,640 deg. C. Probably it is necessary to return in the iron some residuum of the added element, this addition not being soluble and its boiling point being raised, the emulsion is usually imperfect and the yield is therefore very poor. The figures cited above throw into relief the fact that the results obtained when using the metals of this series have been completed, and here it should be made clear that, because of their diminished action on irons of commercial composition (particularly of high sulphur content), all the graphite is not obtained in the spherulitic form. On the other hand, the results on extra pure irons containing no sulphur, manganese, or phosphorus have been perfect, as is shown in Figs. 1 to 4. Actually, the action of these elements is direct and immediate, especially as to deoxidation.

Taking, for example, the elements Li, Sr, and Ba, despite their high price (a hundred times dearer than Mg), they only with difficulty yield suitable alloys. Actually they are not very soluble in the media used for their introduction into the iron (such as Ni, Cu and the like), and they are distinctly hungry for oxygen and so do not remain as metals when attempts are made to alloy them.

TABLE I.—*The Mechanical Properties of Various Cast Irons.*

	Tensile strength, tons per sq. in.	Elongation per cent. Length = 4 times the diameter.	Brinnell hardness.
Pearlitic cast iron with lamellar Gr. LSi 2.0; T.C. 3.4; Mn 0.75 and P 0.1 per cent.	14.7	0.1	198
Iron with "curly" graphite of similar composition	33.0	circa 0.5	200
Pearlitic iron with nodular graphite (same composition)	47.0	4.4	242
Pearlitic and ferritic iron with nodular graphite (Si 2.1; T.C. 3.3, and Mn 0.2 per cent.)	39.0	7.5	220
Ferritic iron with nodular graphite (same composition) but annealed for 6 hrs. at 750 deg. C.	32.0	14.6	170

* A Paper presented before the *Société Française de Metallurgie.* This research was undertaken under the auspices of J.R.S.I.A. and Fabrimetal.

TABLE II.—*Alloy Yields.*

	Mg.	Ni.	Cu.	Si.	Fe.	Al.	C.	Yield,
Mg. Ni	50	40	—	—	—	10	—	8 to 10
	40	60	—	—	—	—	—	9 ,, 15
	30	70	—	—	—	—	—	10 ,, 20
	20	80	—	—	—	—	—	25 ,, 50
	17	81	—	—	—	—	2	45 ,, 60
Mg Cu	10	—	90	—	—	—	—	15 to 21
	20	—	80	—	—	—	—	14 ,, 20
	25	—	75	—	—	—	—	13 ,, 19
	30	—	70	—	—	—	—	12 ,, 18
	40	—	60	—	—	—	—	9 ,, 15
Mg. Si	50	25	—	25	—	—	—	5 to 10
	20	22	—	30	28	—	—	18 ,, 22
	17	10	—	48	25	—	—	20 ,, 30

* The "Yield Per Cent" is a function of the Mg residual remaining in the iron and calculated according to a formula already published (*see* Bibliography).

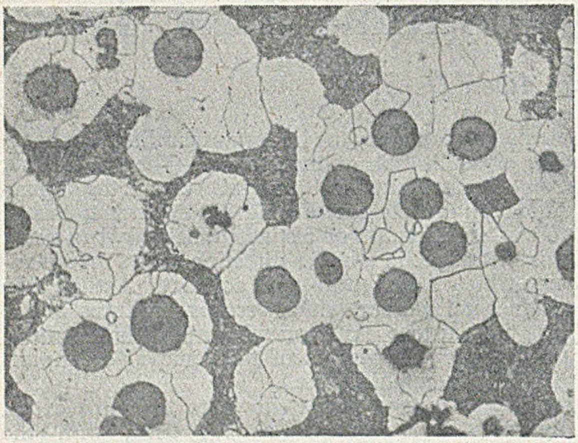

FIG. 1.—*Structure of Lithium-treated Iron.* × 200 *dias. Base Metal contains no S, Mn, or P.*

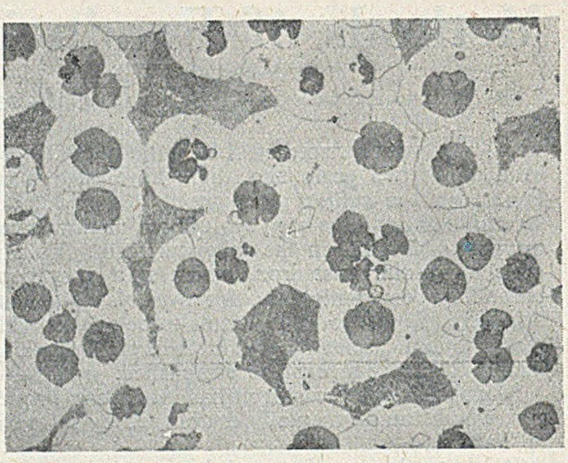

FIG. 2.—*Calcium-treated Iron.* × 100 *dias. Similar Base Metal to Fig. 1.*

The incorporation of the other metals (Mg, Ca, etc.) into iron can normally be done by the use of carrier alloys. It can be said that only the magnesium treatment, and perhaps in the future Ce and Ca have any real chance of survival—the other methods, as has been shown, are ruled out for one reason or another. The Americans have developed and used Ni/Mg and Cu/Mg alloys. The British have worked with Ni/Mg and particularly with Ce incorporated by means of Mischmetall. In Belgium, use has been made of a Ni/Mg/C alloy (81/17/2, the carbon lowers the melting point) and especially the light alloys for which tne basis being Si, Si/Mg (Ni/Fe) with from 15 to 20 per cent. Mg and 50 per cent. Si.

Cerium Treatment

Cerium is often introduced as Mischmetall of the following composition: Ce, 45 to 52 per cent.; other rare earths 45 to 48 (lanthanum and praseodymium); Fe, 0.5 to 4.5; Mn, up to 1.6, and Si, Al, Ca, up to 3 per cent.

(1) Spherulitic graphite is obtained in the Ni/C; Ni/Fe/C, and Fe/C treated hypereutectic alloys in the as-cast state, but the addition to the normal hypoeutectic iron is far from giving the same result. Moreover, the quantity of the necessary additions for the production of the required structure is extremely delicate.

(2) The addition of cerium is connected with the elimination of sulphur. Actually, the combination Ce-S formed is relatively insoluble in the liquid metal and separates from it by liquation, after reaching a certain temperature. If the separating out, arising from the desulphurisation, has not left the cerium content sufficiently high, then the largest part of the cerium being in combination with the sulphur is not useful for the formation of nodular graphite.

(3) It should be pointed out that Mischmetall is expensive (more than ten times dearer than magnesium), and it is thought that its increased use would not lower the price. The conclusion reached is that, if the production of nodular cast iron by

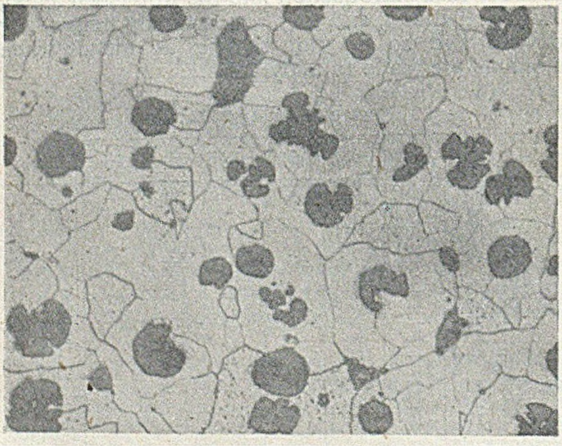

FIG. 3.—*Structure of Strontium-treated Iron.* × 250 *dias. Base Metal without S, Mn, or P.*

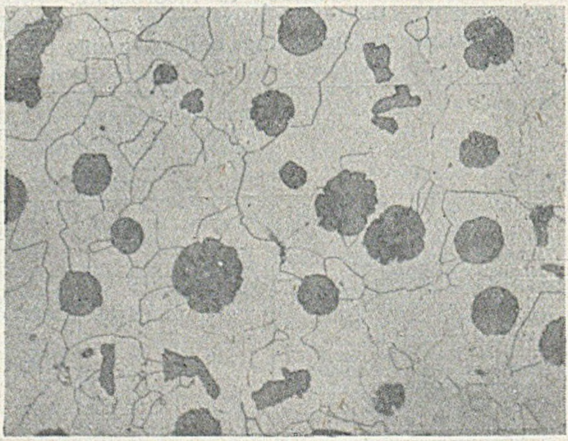

FIG. 4.—*Barium-treated iron.* × 200 *dias. Base Metal Free from S, Mn, or P.*

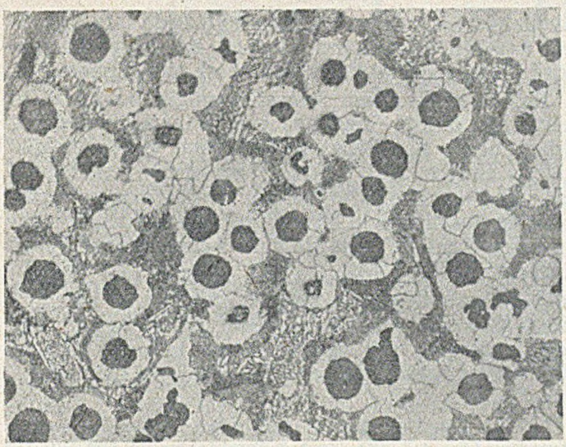

FIG. 5.—*Effect of adding Calcium Hydride to a Synthetic Cast Iron.* × 200 *dias.*

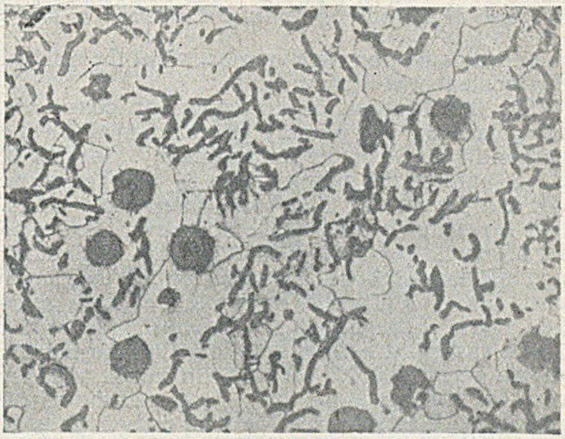

FIG. 6.—*Microstructure after the Addition of Sodium to Cast Iron.* × 300 *dias.*

means of Mischmetall is to be developed, its possibilities will at least have to be established for certain limited and well-defined cases.

Magnesium Treatment

The treatment with pure magnesium under working conditions gives no guarantee of safety or real success. It cannot perhaps be ruled out. Undoubtedly a large number of workers felt from the beginning that it was essential to prepare a binary, ternary or quaternary alloy carrying the magnesium. The element through which the magnesium is introduced into the bath is of outstanding importance. These "carrier" materials should be soluble in the iron without being noxious and they should rapidly be disseminated throughout the mass. High local concentrations of magnesium are thus avoided and there results an intimate emulsion of magnesium in the iron and, therefore, a high incorporation yield (see Table II).

The added alloy should have a relatively low melting point (and from this arises the incorporation of a small quantity of carbon, as for example the alloy referred to earlier in the case where, instead of Ni [M.P. = 1,452 deg. C.], use is made of a eutectic carrying 2 per cent. of carbon with a melting point of 1,375 deg. C. The solubility of the carrier element in the iron ought to be complete and to give in the solid state an alloy in the true sense of the word —a solid solution, an inter-metallic mixture or an aggregate.

Nickel is very soluble in iron; it is thus a very good carrier for the magnesium. Moreover, it combines with this metal as Ni_2Mg and $NiMg_2$. Nickel is therefore outstanding for the production of nodular iron. The specific gravity of the Ni/Mg with a high Ni content being either greater or about equal to that of iron, the introduction is therefore simplified. Nickel retards the graphitisation of the eutectoid cementite and thus tends to give a grey iron with an entirely pearlitic matrix.

So far as copper is concerned, each time that the Authors have tried to replace nickel by this element in the alloys, they have always found that the results

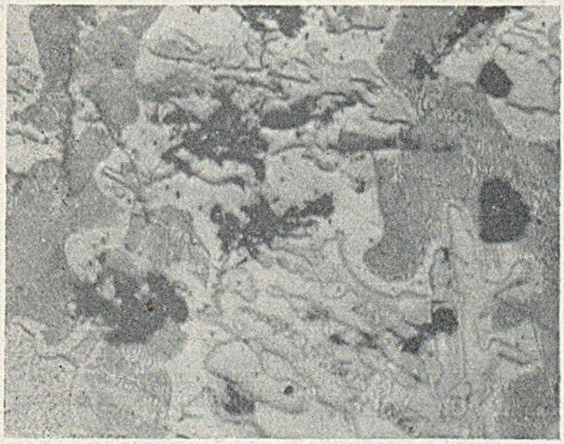

FIG. 7.—*Addition of Boron to Iron. Note the Presence of Hard Borides.* × 250 *dias.*

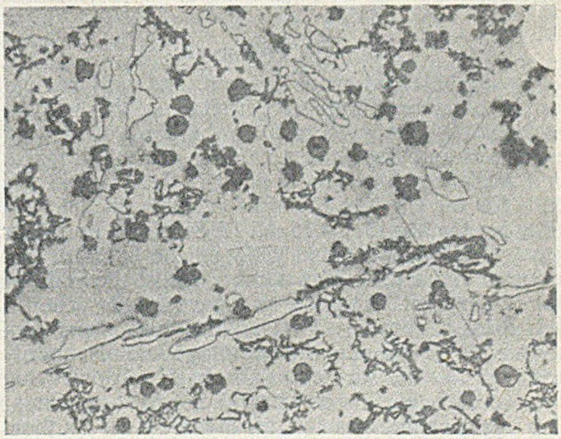

FIG. 8.—*Structure obtained by adding Tellurium to Iron* × 150. *In this Case Tellurides are Present.*

Methods of Producing Nodular Cast Iron

obtained in the iron were inferior, whilst the residual Mg content was more critical.

The first function of silicon in iron consists in bringing about the primary precipitation of all the carbon in excess of the solid solubility. Moreover, the Si hardens the matrix (about 8¼ tons per sq. in. per unit per cent. of the Si) and lowers the ductility.

It is recommended that the Si is never allowed to be below 1.8 per cent. in nodular iron. For small and medium sections, a content of 2.2 to 2.5 per cent. silicon is generally satisfactory when a pearlitic matrix is sought. If a ferritic matrix is wanted in the casting, it is then necessary that the final Si should be at least 2.8 per cent. (in excess of 3 per cent. the elasticity is too low). However, the silicon should be correlated with the total carbon so as to give the eutectic composition (it can be higher eutectic for thin-section castings) with the object of obtaining a pearlitic, semi-pearlitic or ferritic structure in the matrix.

These general principles, therefore, permit the drawing of conclusions, which can show the steps to follow in each particular case. At the Ghent research centre, the Authors have finally decided on alloys of two types:—

(1) The heavy alloys 80:20 Ni/Mg, with a theoretical specific gravity of 7.38; 81:17:2 Ni/Mg/C (s.g. 7.45) and 80:20 Cu/Mg (s.g. 7.4).

(2) Light alloys with a silicon base and the one giving the best results is 47.5:17.5:10 to 15 (remainder Fe), Si/Mg/Ni (s.g. 4.2). The light alloys are distinctly cheaper than the heavier ones; their yield, however, is lower, and they require special but quite simple apparatus for their introduction. On the other hand, they assure an excellent separation of the products of the reaction and introduce a very appreciable economy through the possibility of using low Si content raw materials such as steel scrap.

All these alloys, suitable for the making of pearlitic nodular iron, have been specially studied also for the production of ferritic or mainly ferritic nodular irons.

Calcium Treatment

Having obtained encouraging results with calcium (see Fig. 2), the Authors have tried to use this element combined with Mg, more from the point of view of cost economy than for anything else. A Mg/Ca unit works out much more cheaply than a plain Mg unit, for the Ca was added as calcium silicide. An alloy having Mg 15, Ca 15, Ni 15, Si 45 and Fe 10 per cent. gave the calculated yield on the bases of Mg alone of more than 30 per cent., whilst the yield of the 15 per cent. Mg alloy only gave 25 per cent.

However, some real difficulties have been encountered. The Ca of the alloy oxidises unduly and rises to the surface of the bath before having been completely dissolved and forms a granular slag. Moreover, other alloys made by the Authors and containing Ca, but free from Si, have the drawback of not possessing a state of conservation at the ordinary temperature during the limited time available. A test with calcium hydride (see Fig. 5) on a synthetic cast iron turned out very satisfactorily; the graphitisation iron being truly spherulitic.

Before concluding, reference might be made to some not entirely negative experiments carried out when using potassium, sodium and boron—a distinctly electropositive range, excessively reducing in character—and also tellurium, the latter a powerful carbide stabiliser and frequently used as such in iron-foundry practice. The difficulties encountered were:

(1) With the potassium and sodium (see Fig. 6), lack of solubility in a medium capable of carrying them into the iron; their boiling point, being quite low, causes a very violent action to be set up in the bath of liquid metal and thus prevents the making of alloys.

(2) As for boron and tellurium, the residues of borides (see Fig. 7) and tellurides are difficult to eliminate even by secondary inoculation with Fe/Si. The best result with Te was that obtained with an iron of C 4.2, Si 3.0 and S 0.045, with a 0.3 per cent. addition. Other treatments were used: (*a*) as pure Te in an ordinary iron (C 3.5, Si 2.5 and 0.08 S per cent.); (*b*) after preliminary treatment with Mg/Si/Ni, and (*c*) with the alloy Te/Fe/Si/Ni. The irons always showed numerous varieties of graphite, yet never entirely spherulitic.

Conclusion

In conclusion, after having considered the various methods actually known for the production of nodular irons, it would appear that the treatment with Mg is now established as the most economical one, and though it introduces certain casting troubles, it is the best from the point of view of actual results obtained and most certainly shows the most potentialities in the commercial field.

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Foremen's Associations

The business side of the FOUNDRY TRADE JOURNAL from time to time records the activities of foremen's associations, which have been established either by large works or groups of smaller ones. We have just received details of one serving the interests of foremen at the Beeston Boiler Company, Limited, of Beeston, Notts. The members pay 10s. a year (associates 5s.) and since its establishment about two years ago they have had some 15 lectures covering a wide range of both commercial and technical subjects. In addition, there have been ten works visits, including trips to Birmingham and London for exhibitions. No fewer than eight of the members are also either members or associate members of the Institute of British Foundrymen and foundry subjects feature very largely in the programme. This is a highly commendable organisation; it has, as it well merits, the active support of the directors. Mr. W. F. Cookson is the chairman and Mr. C. Powney the secretary, and it is indicated that they will be only too happy to give the benefit of their experience to interested parties.

Fumes from Oil-bonded Cores

Advisory Committee's Report

FOLLOWING THE ISSUE of the Garrett Report* in 1947, a permanent committee was set up representing the factory inspectorate, employers, trade unions and the Ministry of Supply to enquire into and propose means of improving conditions within the foundry industry. This committee in turn has instituted a technical sub-committee, comprising mainly users and suppliers of foundry equipment and materials, which has just issued its "Technical Report on Practical Methods of Reducing the Amount of Fumes from Oil-bonded Cores."† What follows is an abstract from the opinions expressed and summaries of the main conclusions:—

General Considerations

The amount of fume evolved from core sand during casting can be reduced by the correct use of the core binders, and is, in point of fact, often increased by their incorrect use. Every foundry, however small, can keep the amount of fume from core binders to a minimum by exercising care and thought in the use of binders. It is of course essential that foundrymen should appreciate the importance of the actual mixing operations and too many foundries use rough-and-ready methods at the sand mixer. Cleanliness is most important at the sand mill. All measures and tools should be kept clean and maintained in good working order or the sand mixing process will inevitably deteriorate. Materials should be stored in an orderly fashion, especially where several different binders are used. Foundrymen sometimes have bought binders from different makers and used the same practice for all the binders; this is clearly wrong.

To avoid incorrect mixing it is desirable that the number of mixtures used in a foundry be reduced to a minimum. Managements should then ensure that every operator has full and lucid instructions as to the quantities, materials and methods to be used in each mix, and it may be desirable to give these instructions in writing. A common cause of excessive fumes is the extravagant use of binders. Only the minimum amount of binder should be used. It is appreciated that if the proportion of binder is limited to any considerable extent, the limits of time and temperature which must be used in baking will require closer control.

Finally, attention is drawn to the need for close co-operation between the user and the manufacturer of the binders. The fullest advantage should be taken of the fact that all binder manufacturers will give assistance in the use of their products.

Summary:—

(1) Attention should always be given to the technical control of operations in core-shops.

(2) The importance of the mixing operations should not be underestimated.

(3) A high standard of housekeeping should be maintained in the core-shop and in the core-sand mixing plant.

(4) The number of mixtures used should be reduced to a minimum.

(5) All operators should be provided with full and clear instructions.

(6) The extravagant use of binders should be avoided; and

(7) The core-binder suppliers should be consulted in the choice and use of binders.

Storage of Binders

The method of storing binders is important, but the wide variety of binders available makes it impossible to give detailed suggestions for each one. Suitable conditions are determined by the character of the binder; old stocks should be used first. In general, binders should not be stored in extremes of temperature and, in the case of powder binders, dampness should be avoided.

Sand

The amount of binder needed for any given strength depends largely on the total surface area of all the grains of sand in the core. This specific surface, as it is called, increases rapidly with decrease in grain size. With small increases in the amount of very fine grades this effect becomes most pronounced. Clay in particular greatly increases the amount of binder needed for a given weight of sand if the properties of the core are to be maintained. The proportion of clay and other fines should therefore be restricted to the minimum amount required for adequate "green" strength to prevent sagging or to give resistance to metal penetration.

After sand has been dried there is often a tendency to use it while it is still warm, due to the difficulty of cooling a large mass of hot sand. The result is that, when mixing with the requisite amounts of binder and water, the latter tends to evaporate and it is much more difficult to prepare the mixture with adequate plasticity without using an excessive quantity of binder. The provision of cool sand will therefore enable smaller quantities of binder to be used.

Mixing

There is no doubt that in making the core-sand mixture the most desirable method is to weigh the quantities of all materials used, including the sand. On the other hand, it is recognised that this is not always practicable when large quantities of materials have to be handled in the shortest possible time. A weight basis should be used, however, when deciding on the mixture, and where containers are used which in fact measure volme, the weight they hold should be known. The container should be selected so that it can be filled properly in such a

* Report of the Joint Advisory Committee on Conditions in Ironfoundries—H.M. Stationery Office (6d.).

† H.M. Stationery Office (4d.).

Fumes from Oil-bonded Cores

fashion that the same weight is delivered to the mixer each time it is used. The possibility of including air locks when filling a container with semi-solid binders should not be overlooked. For this reason it is recommended that semi-solid binders be weighed in all cases. There is no doubt that any attempt to add a known weight of a semi-solid binder by the measurement of its volume is open to grave criticism. We also consider it necessary to point out that if sand is measured by volume a container with sides and a level top should be used; a shovelful of sand, for instance, is a very indefinite and variable weight. The top edges of the container should be level so that the operator can strike off any excess sand after filling the measure.

Summary:—

(1) All mixtures should be made on the basis of weight.

(2) Semi-solid additions should be weighed.

(3) Full details of each mixture should be determined.

(4) Strict control should be exercised to ensure that there is no deviation from the specified mixture.

Storage of Mixed Sand

Far too little attention is given in many foundries to the storage of mixed sand. In certain cases, where rapid air-drying properties are needed to avoid sagging, storage becomes a major problem because the mass of mixed sand dries so quickly that it becomes unusable before the operator can deal with it. On the other hand, where the position is not so acute, there is a general failure to recognise the fact that mixed core sand is air-drying continuously. This results in the addition of larger amounts of the binder to obviate the difficulties, which could equally well be overcome by proper storage. Sand that will be used within a few hours of mixing may be adequately protected by covering with damp sacking. On the other hand, sand which is to be stored overnight, or longer, may need air-tight containers in addition to a cover of damp sacking over the surface. Owing to the great variation in the circumstances in individual foundries it is considered undesirable to specify detailed methods of storage, but care should be taken to attain the lowest possible rate of evaporation of the moisture from the sand.

Baking

There is little doubt that the extent of fuming can be minimised by the thoroughness of baking, and a number of foundries could reduce the amount of fumes given off at, and after casting, by the avoidance of underbaked cores. The first necessity is to use an efficient stove in which temperature can be controlled. Whilst it is not proposed to recommend any particular type of stove or form of heating it is extremely difficult to control stove temperatures when using an ordinary open fire as the source of heat.

When the correct baking cycle has been ascertained, it should be rigidly controlled to avoid erratic baking of similar cores. The exigencies of the foundry will necessitate some variation in the sizes of the cores in a stove at any one time but every effort should be made to restrict this variation in size so far as is possible. The reason for this is that where large and small cores are baked together the large ones will be underbaked when the small ones are correctly baked, with the result that the large ones will evolve more fume than necessary on casting. In the case of batch stoves, the cores should be batched in such a fashion that all cores need the same time for baking. This will avoid the necessity for the constant opening and shutting of the doors of the stove. Hot fuming cores should either be cooled in the cooling chamber of a continuous stove or be placed under a hood fitted with local exhaust ventilation. Suitable flue systems should be provided to all stoves so that the fumes from the stoves do not enter the air of the foundry or core shop.

Summary:—

(1) Cores should not be used if underbaked.

(2) The most satisfactory baking cycle should be ascertained and subsequently rigidly followed.

(3) So far as is possible cores of a similar size should be baked together.

(4) Every effort should be made to avoid the constant opening and shutting of batch-stove doors.

(5) Fuming cores should be cooled either in the cooling chamber of the stove or under a hood provided with efficient exhaust ventilation.

(6) Stoves provided with means for recording and controlling temperature should be used.

(7) Stoves should not be heated by an ordinary open fire.

(8) Adequate flue systems should be fitted to all stoves to ensure that the fumes from the stove do not enter the foundry or core shop.

The fumes escaping from the vents after casting will often burn. Care should be taken in all cases to see that all inflammable gases issuing from the vents are in fact lighted, and continue to burn so long as the gas will support combustion. To facilitate the lighting of vents it is recommended that the number of separate vents should be kept as low as possible.

Types of Cores or Moulds

Wherever possible the use of large masses of oil-bonded sand should be avoided. For this reason the use of "shell" cores is advocated. It is appreciated that this may not be possible in all cases, but the advantages to be gained in the reduction of fumes on casting are sufficient to warrant close consideration being given to the possibility of using these shell cores in any case where a large core is essential.

In core-block moulding, the mould as well as the core is made of oil-bonded sand and, therefore, it is more than ever necessary that the minimum amount of binder should be used, even though this will demand accurate control of baking conditions. It is also desirable in this case to cast under a hood fitted with efficient exhaust ventilation to carry the resultant fumes from the foundry.

Ordering of Die Castings

By W. M. Halliday

The advantages and economies inherent in the pressure and gravity die-casting processes are now well-known. Unfortunately, their limitations and basic design requirements for the component are far from being equally well understood, particularly by designers and prospective users. Close co-operation between the die-caster and the customer is essential at all stages if delays and misunderstandings are to be avoided.

IN MANY CASES only the scantiest amount of information is given to the die-caster regarding the specific purposes and functions to be fulfilled by the die-cast article; the degree of accuracy required, and the general quality standards to be attained are often not clearly stated. Reasons are rarely given for the adoption of specific design features incorporated in the component. Unless a sufficient amount of freedom and latitude is permitted the die-caster in respect of modifications to the shape, size, and features, it may often happen that the most suitable type of casting cannot be produced. On the other hand, the cost of such productions and the necessary dies may be much higher than would otherwise be the case. Moreover, this common failure to supply sufficient guiding data at the initial stages of an enquiry may lead to considerable delay. The die-casting engineer will have to elicit this information before the die design can be evolved, and any reliable estimate made of manufacturing costs.

An effective method for avoiding these difficulties is to employ a standard "questionnaire" of the kind detailed in Chart I. A copy of this questionnaire is sent to the prospective user if his enquiry lacks any essential information. Seventeen points are embraced therein, covering most of the critical items about which accurate information should be given if the die-caster is to make a reliable and economical estimate.

Quantities Required

All die-casters at times receive enquiries of the following type, after which their troubles will begin:—

> Enclosed is our drawing of component number...... which we desire as a pressure die casting. Will you please quote lowest price for the supply of 10,000 parts substantially as drawing specifications, together with earliest delivery date.

In the first place, this enquiry omits to indicate the type of die-casting alloy to be used. Furthermore, the drawing or attached specification will afford little guidance to the die-caster as to the service conditions to be satisfied. Lacking this information, and because there are several grades of zinc-base alloy, and numerous aluminium casting alloys, the die-caster will be in great doubt as to the type of material to be used and quoted.

From such a quotation the caster would be justified in assuming that only the stated quantity is required. In actual practice, however, it frequently happens that a repeat order comes along for a greater quantity. This may lead to innumerable difficulties and added costs. For moderate quantities, from 5,000 to 10,000 parts, the die-designer would probably employ a simple type of single-cavity die. Such a tool would be fashioned for purely manual operation, or at best semi-automatic operation of cores, etc. The material employed in the die would doubtless be ordinary mild steel, unhardened. All this would be done to keep die costs low, and produce a tool capable of producing only the given quantity of parts.

If, however, after such a tool has been made and has produced the initial batch of parts, further orders are required, it may be found that the die has become so badly worn, inaccurate, or damaged as to render it incapable of producing further large quantities without drastic and expensive overhaul. Often a completely new die may have to be made, with commensurate increased die charges passed on to the client. On the other hand, for quantity production, *i.e.*, 20,000 and above, a larger multiple-impression die would be designed, this being constructed for full automatic operation. The material used would be an alloy steel, suitably hardened to give long working service, and to retain its initial accuracy. More rapid production would also be obtained from a die of this kind, thus reducing unit costs appreciably.

Even though a relatively small quantity is called for in the first order, if the die-caster is informed at the outset that further orders may be required, usually he will be able to make provision in the original die design for the inclusion of additional cavity formations at a later date. He would also be more correctly guided as to the type of die materials to be used. Quantities determine the character of numerous secondary machining operations such as trimming, drilling, tapping, polishing, etc. With dies of very simple design and low cost the designer may eliminate certain cored holes, or other features, preferring to machine these at a later date to ensure quicker or safer operation of the die. With large quantities, however, for which a larger and better constructed die may be used, all features would be reproduced directly in the casting, thus obviating several secondary machining operations, so reducing costs still further.

Deliveries

It is helpful for the die-caster to know in advance exactly how supplies will be required. Most die-casting foundries are equipped with a number of small-capacity machines, and a few large ones, these being used exclusively for large multiple-cavity dies or the production of large-size castings.

Ordering of Die Castings

If a quotation has been given on the basis of supplying all parts in a single-batch delivery, these may be produced from a multiple-impression die in conjunction with a large machine, so as to obviate an unduly long production run on one of the smaller-type machines. Should instructions be given later, however, to supply small quantities at stipulated intervals, as often happens, it might prove uneconomical for the die-caster, since production runs of a large and expensive machine would have to be interrupted several times.

Service Conditions

Information should be given at the outset respecting the degree of precision, loading, and application of the die casting. Some castings are required for purely decorative or ornamental purposes, while others may have to be subjected to all kinds of stressing. The die-caster should be advised whether the casting has to have high-quality surface finish and attractive appearance, or whether it will be exposed to gas, steam, water, chemicals, heavy mechanical loading abrasion, rubbing action and so forth. This information will determine the proportions of wall thickness, ribs, bosses, and similar stiffening provisions, coring in the die, and the type of alloy to be used.

The die-caster, by reason of his expert knowledge of casting properties, will often be able to advise or suggest useful modifications to the shape or features to meet specific service requirements.

Component Weight

Weight is often a limiting factor with the client, but it is always of extreme importance to the die-caster. It determines, for instance, the number of cavity impressions to be employed in the die; their layout; the gating and runner feeding provisions; the wall thickness and variations permissible; the ability to core out the casting; the shrinkage of the component, and its general accuracy. To a lesser extent this will also determine the tendency towards porosity, and other irregularities.

Considerable difficulty may be encountered when calculating weights from dimensions and shapes given on a client's drawing. If the configuration is complex, or the drawing lacks clarity in respect of critical dimensions, additional difficulties may arise, which might, and often do in practice, lead to inaccuracies, unsatisfactory casting, and increased costs.

Drawing Dimensions

Drawings are often supplied in which the respective views are drawn to an unsuitable scale, or with portions insufficiently dimensioned. As a result, the die-caster may have to make computations before specific dimensions and sizes can be ascertained. On the other hand, he may fail to gain a clear conception of the shape of the proposed component. Thus, unsatisfactory die designs may ensue, causing increased manufacturing difficulties, costly corrections, and the formation of an unsuitable die casting.

Every portion of the drawn component must be clearly depicted and all dimensions plainly marked. In laying out dimensions care has to be taken against accumulative error occurring over a series of such items. All dimensions should be provided with tolerances, these of the maximum amount. Exceedingly fine tolerances should be avoided, as these may be difficult to attain, and in any case will involve the strictest accuracy in making and using the die. Non-essential parts of the proposed casting should be plainly indicated, especially in respect of sizes and tolerances. The dimensions should be located from some clearly established datum, thus obviating the need to make calculations when ascertaining certain critical measurements.

Design and Shape of Component

If the fullest advantages of the die-casting process are to be gained, the component should be specifically designed for reproduction by this method. It should not be a slavish copy of a component form designed primarily for manufacture by some other process, such as sand moulding, machining, pressing, etc. This important fact is often overlooked by the potential user when evolving a component design.

Upon receipt of a drawing the die-caster will first try to visualise the entire shape of the piece. He will also have to visualise it in reverse form, as it will occur in the die cavity. With complicated shapes this is extremely difficult even when attended by clear and unambiguous drawings. If drawings are inappropriately scaled, or illegible, or wrongly dimensioned, these difficulties will be intensified, and may inadvertently result in unsatisfactory die forms, leading to later troubles when making or using that tool.

To avoid all these risks the views presented on a drawing should be capable of the easiest interpretation. Ordinary orthographic projections are unsatisfactory from this angle. Wherever possible, isometric pictorial views should be given from which the whole shape and form of an article may be quickly and correctly understood. Critical features required, such as cored holes, ledges, undercuts, internal contours, angularly disposed slots, side openings, threads, etc., will be more accurately appreciated and adjudged as to their castability.

It should be established at the outset of any die-casting project in what measure the die-caster may use his discretion to modify design forms laid down by the user. Latitude in this way will enable the die-caster to locate parting-line surfaces in the die with greater ease, to determine wall thickness, and in what manner portions have to be strengthened by ribs, bosses, beadings, and the like, and generally to provide a more satisfactory casting.

Surface Finish

Many component drawings fail entirely to provide indications of the quality of surface finish desired. Where great smoothness and high polish is desired, the walls of the die cavity will have to be similarly smooth and lustred. Very often such surfaces can only be reproduced in the die cavity as a result of hand buffing and polishing, which because of the skill required is very costly. Even with purely

CHART I

"Questionnaire" for Buyers of Die Castings

Regarding your enquiry for .... Gravity/Pressure die castings made in .... alloy, will you kindly provide the following additional information?

1. *Full Quantity of Parts Required* .... (This to include not only initial quantity, but also subsequent orders anticipated.)
2. *Delivery Requirements* .... (Please state quantity required per week or month, and nature of delivery schedule to be observed.)
3. *Working Conditions* .... (Describe exact character of service conditions, i.e., whether casting is intended for decorative, or utilitarian, purposes, nature of loads, or other unusual stringent requirements.)
4. *Weights.* Max. and Min. weight given .... (Can max. and min. weights of part be given? Alternatively supply weight of existing part in non die-casting alloy, stating kind of material.)
5. *Dimensions.* Tolerances, non-critical, and important sizes .... (Kindly indicate non-essential dimensions and max. tolerance permitted, and confirm that our usual limits .003 in. will be satisfactory for such portions of casting. Are all vital tolerances plainly marked on your drawings?)
6. *Design.* Can latitude be given to modify shape, size and/or location of certain features on component? This may be advisable or necessary to ensure economical die design, more satisfactory castings, and reduced costs. Please denote all non-essential features on drawing ....
7. *Surface Finish.* Please indicate quality of surface finish desired, and whether casting is to be supplied in self-colour, or type of finishes required, i.e., Electroplated, Sherardised, polished, painted, etc. ....
8. *Assembly.* Is component part of larger assembly? If so in what manner will it be located, fastened or related? Could a sample of such larger assembly unit be supplied for inspection?
9. *Special Service Problems.* Can you explain any special service difficulties experienced with component now proposed as a die casting? ....
10. *Inscriptions and Lettering.* Has casting to be formed with cast-on lettering, symbols, designs, etc.? If so, are these to be in raised or sunken form on the side of part Please indicate exact location of all such features ....
11. *Inserts.* Is it proposed to mould insert components *in situ*? If so, please state material, degree of accuracy expected, and who will supply such components, together with scale of delivery ...
12. *Special Features.* Please describe all special features, requirements, etc., re gauging, testing or inspecting finished castings, or checking later machined portions ....
13. *Gauge Supplies.* Kindly inform us of who will supply gauges, and whether checking masters will be supplied ....
14. *Sample Component.* Can an actual full-scale model of component be supplied; if so, denote all critical dimensions, surfaces, and features, also stating material employed in model ....
15. *Threads.* With threaded portions, kindly state nature of fits desired, whether joints have to pass steam-, air- or water-pressure tests, magnitude of same, and if possible provide samples of machined threaded articles to be fitted ....
16. *Delivery.* Can you give date of first delivery required, also minimum quantity? ....
17. *Die and Tool Charges.* Our usual practice is to quote part cost of dies and tools, *i.e.*, 60 per cent. payable when placing order, remainder upon approval of castings. Castings quoted separated on unit or batch basis unless otherwise requested. Die to remain in diecaster's possession, maintained in correct working order by him free of charge to client. Alterations due to change in design, or sizes of component chargeable at cost.

decorative types of die castings not all surfaces have to be of such a high polish and smoothness; therefore, in the interests of economy, the critical surfaces should be plainly marked on drawings for the guidance of the die-caster.

When electroplated finishes are required, fullest information of the kind of such treatment should be given to the die-caster at the outset. With the manufacture of die castings having to be finished in this manner, considerable care has to be taken to eliminate all tendencies towards porosity and surface irregularities such as flow lines, seams, cold shuts, and hot-shorting, all of which will entail considerable difficulties when plating. Essential surfaces have sometimes to be painted, or chemically dipped, to provide the final finish. Full details of all such processes and requirements should be supplied.

Samples and Models

If the die-caster can be supplied with a model of the proposed component, considerable assistance will be derived. If this is accompanied by a sample of the larger assembly unit into which the part is to be fitted, so much the better. Being able to handle, measure, and weigh such a sample makes it more simple to assess the machining and designing requirements in the die.

Cast-on Inscriptions

Many titles, numbers, and inscription devices may be cast on the component, but the main point to be observed is whether such lettering has to be raised, or sunken into the casting wall. Sunken impressions in the component usually involve large amounts of machining on surrounding areas of the cavity wall to produce the necessary raised impression. Thus, these will be more costly than raised impressions on the part, which can be formed by sunken forms in the cavity wall. Very often the user will decide to incorporate inscriptions or symbols at a later date after samples of the casting have been supplied. This often entails added cost, because essential portions of the die will have been completed and hardened ready for use.

Joint Liability

At Leeds Assizes, J. S. Whincup, a plumber, was recently awarded £833 damages by Mr. Justice McNair for injuries sustained when he fell nearly 30 ft. through an asbestos-lined glass roof. The action was brought against his employers, Joseph Woodhead & Sons (Engineers), Limited, sanitary and heating engineers, of Charlotte Street, Wakefield, and against J. W. Harrison, Limited, engineers and ironfounders, of Wakefield, at whose factory Mr. Whincup was repairing broken panes in the roof when the accident occurred. The judge held that both firms were equally liable for breach of statutory duty, and he ordered them to share the damages, with costs.

Contractors Plant

The Federation of Manufacturers of Contractors Plant, River Plate House, 12 and 13, South Place, London, E.C.2, is strongly supporting the British Industries Fair, which is to be held from April 30 to May 11, 1951, at Castle Bromwich. Members will be occupying a space of 70,000 sq. ft. in the open air, and with the exception of one or two firms who are retaining stands occupied in previous years, will be grouped together.

A Nineteeth-Century Foundry

By T. R. Harris

FROM THE FILES of old local newspapers, glimpses can often be caught of the interesting details of the happenings of a byegone day. Recently turning over the pages of such files, the writer came across a number of sidelights on the activity of the Hayle Foundry of Harvey & Company, the famous engineering firm of the last century.

The cordiality which existed between the management and the men at the works was expressed annually by their dining together. In December, 1844, it was reported that "on Saturday last, according to annual custom, Harvey & Company entertained about 300 of their workmen with good old English fare, Roast Beef and Plum Pudding. The men all dined together in one of the large rooms in the works, which was tastefully decorated with evergreens, the tables being headed by the Captains of the different departments. Some of the principals of the firm, together with several friends spent the evening in the most convivial manner with the men."

Later, as the number of employees increased, the dinner was held on two separate occasions in the Drill Hall, the men from the fettling shop, hammer mill and smiths' shop, numbering about 380, being regaled one Saturday, while their colleagues in the pattern shop and moulding shop, together with the shipwrights and others were feasted the following week. In March, 1872, between 700 and 800 men dined at the expense of the company.

In the 'seventies, the moulders dined together annually; apart from the general dinner at the expense of the company, "in consequence of their commuting an allowance which formerly the moulders received for ale, for every casting of a certain kind, for such an event." The report of the dinner held in October, 1872, recorded that at this function each person was allowed to choose the kind of drink he desired, intoxicating or otherwise," but there is a large and increasing number of teetotallers among them, thus accounting for the change." At the dinner of 1873 the foremen of the other departments joined the moulders in their festivities, while the manager and assistant manager, Mr. William Husband and Mr. N. J. West, presided at the table "when about 100 partook of the ample fare."

From the report of a Royal Commission of 1841 we learn that at that time the only holidays enjoyed by the workers at the foundry were "Christmas Day and Good Friday, the latter not always so." By the 'seventies, however, Easter Monday was becoming recognised as a holiday, but even this was not always enjoyed. For instance in 1873 it was reported that "Easter Monday at Hayle was rather quieter than usual owing to the factory having several jobs in hand wanting speedy completion, and preventing the workmen having the usual holiday." Like at the tin and copper mines, the workers in the foundry kept up Midsummer, and later, in 1873, we read "The employees of Messrs. Harvey & Company celebrated Midsummer day by leaving work an hour earlier than usual."

By the 'eighties notices of excursions appear; on a Saturday in August, 1886, for example, it was reported: "A number of employees of Hayle Foundry passed through Penzance *en route* for the Lands End where they enjoyed their annual summer excursion, whilst another contingent visited Kynance Cove and the Lizard."

Glimpses, too, of the working of the foundry can also be caught from those casual news items. For example, in June, 1873, it was reported: "A man engaged in Messrs. Harvey & Company's moulding foundry was struck by the handle belonging to a crane and had his nose broken." This item recalls that the massive cylinders and engine beams cast at this foundry had all to be lifted by means of jib cranes, manually operated. Later, in 1873, we read: "On Thursday evening as the workmen in the moulding shop of the Hayle Foundry were engaged in fitting together a large cast-iron pump box they had a narrow escape. In turning over the moulding box it suddenly broke in two parts. Fortunately all were standing clear and no injury resulted."

Notices of unusual work undertaken are also to be found, as in March, 1871, when it is reported: "A large four-bladed screw was successfully cast on Monday at the works of Messrs. Harvey & Company under the supervision of Mr. Wm. Richards for a steam boat which put into Falmouth last week with three blades of her propeller broken. Considering the mould had to be made for the broken screw, which was only received at the yard on Thursday afternoon, the moulding must have been done very expeditiously."

From a report of an industrial exhibition held at Hayle in 1884 we learn that "the iron and bronze castings of the late John Whitebread, a German (the above is his adopted English name) who resided for some time at Hayle and whose works Mr. Husband and other gentlemen kindly collected from their owners form a prominent and most interesting feature of the exhibition. Mr. Whitebread was a most ingenious caster in iron and bronze. The works exhibited were made by him while at Hayle and are such as could only be produced by a thorough adept in the art. They comprise a crucifix, inkstand, candlesticks, the figure of a basket man, etc., the design in some of the articles being very elaborate. The candlesticks in particular, the top and bottom of which are connected by a human figure are beautiful works of art constructed in iron."

"Review of Progress"

"REVIEW OF PROGRESS, 1950," is a booklet issued by the United Steel Companies, Limited, for distribution to the staff, of whom there are about 30,000. One of the items of news it contains is that a new central research laboratory to replace the one at Stocksbridge is to be built in the grounds of Swinden House, Rotherham. Whether the editor of this booklet has clarified the complexities of the Companies Balance Sheet and Profit and Loss Account, he has certainly gone far in this direction. "Cake Cutting" is apt to be over-simplified. Those responsible for the production of this interesting booklet are to be congratulated.

Improvements in Electric-furnace Design

By F. V. Lewis, M.A.

ALTHOUGH THREE-PHASE direct-arc steel melting furnaces have been in use for many years, they have been improving continuously mechanically and electrically, both to simplify the steelmaker's difficult task and to help him increase his output and improve his efficiency. The cumulative effect of small but progressive steps is far more difficult to assess than a sudden change, and for this reason the particular installation described here is of special interest.

This furnace—a model T.S. Birlec Lectromelt, capacity ½ ton, rating 300 k.v.a.—was installed in late 1946, and was fitted with a contactor type of controller. At that time, the contactor type of automatic electrode control gear, many of which are still carrying out very excellent work, was the usual type fitted to this kind of furnace in Europe, although the Americans had already begun to fit their furnaces with rotary controllers. Early this year the electrode controller supplied with the furnace was taken out, and the latest type of rotary controller substituted. This gave an excellent opportunity of comparing the performance of the furnace before and after the changeover, although it is felt that six months is perhaps rather a short time on which to base final figures. A schematic arrangement of the furnace and the electrical control gear of the rotary type is shown in Fig. 1.

The power given to the charge is determined by the current and voltage in the arc between each electrode and the charge at any instant. The value of this power can be varied by lengthening or shortening the arc, and the electrode is moved by means of a winch motor (M) which drives a cable drum through a reduction gearbox. The cable passing over this drum is fixed, after passing over a pulley system, to the electrode arm at one end, and to a balance weight at the other, so that any rotation of the winch drum will immediately alter the position of the electrode either up or down, depending upon the direction of drum rotation.

The winch motor is a d.c. shunt-wound machine, permanently excited at a constant voltage. The armature of the motor is directly connected to the output terminals of the d.c. generator (G), and will move in a direction and at a speed determined by the polarity and voltage across the generator terminals. The generator itself is of a special type, known as the "Amplidyne." It has an extremely rapid response to changes in excitation, and also a very high amplification factor, *i.e.*, a small variation in excitation will produce a large variation in the "Amplidyne" output. In addition, its output is very closely proportional to the excitation. The output of the "Amplidyne" will follow very rapid changes in its excitation, both in magnitude and in polarity. The electrodes can, therefore, be moved either up or down and at a speed which is controlled solely by the voltage and polarity of the relatively small excitation power applied to the "Amplidyne" control field winding.

Connections are taken from the secondary busbars and the furnace bath, and this voltage—which is proportional to the arc voltage—is applied to the full-wave rectifier (V); d.c. current from this rectifier, which is again proportional to the arc voltage, is passed through AB, and a voltage drop across AB proportional to the arc voltage is, therefore, produced. In a similar manner, a voltage drop across BC is derived from a full-wave rectifier (W) connected across a current transformer, fitted on the furnace busbars. The voltage drop across BC is, therefore, proportional to the arc current. The "Amplidyne" control field is connected between the slider (D) of potentiometer rheostat (AB) and the outer end (C) of resistor (BC). The connections are so made that the voltages across AB and BC oppose each other.

Operational Mechanism

In this way it is clear that, for a certain ratio of arc voltage and arc current the potentials at D and C will be equal and no current will flow in the "Amplidyne" excitation field. The position of the slider (D) along resistance (AB) can be used to determine this ratio. The equipment is so arranged that too high a current—and therefore excessive power in the arc—will produce a voltage across DC which energises the "Amplidyne" in such a way that the winch motor is rotated to withdraw the electrode until balance is once more restored. If the current is too low, the polarity of the voltage across DC is reversed, and the electrode is moved towards the charge. Apart from the greater simplicity of the equipment and absence of contactors requiring regular maintenance, greater electrode speeds can be achieved without danger of "hunting" of the electrodes, as the speed of corrective movement of the electrodes when near the desired position of balance is proportional to the out of balance. In other words, as the electrode moves towards its balanced position, its speed of movement is progressively reduced until balance is achieved.

The main circuit-breaker on this type of furnace is practically always fitted with an inverse and definite minimum time-lag relay, which allows an overload to be sustained for a predetermined time, depending upon its magnitude. Clearly, with increased electrode speeds under conditions of out-of-balance, the duration of any overload will be reduced inversely as the speed of the electrode. In this way short circuits between an electrode and the charge will be cleared in a shorter time than was possible with the contactor type of control and the time-lag period on the overload relay will be reached far less frequently. Thus, apart from the accuracy of control of the system, output will be increased and circuit-breaker and oil maintenance decreased due to less frequent operation of the breaker on overload.

Results obtained on the installation recently converted illustrate the inherent advantages of this

Improvements in Electric-furnace Design

system. The users of this small furnace, who melt a wide variety of steels, claim that the equipment is showing a saving in k.w.h. per ton which varies slightly, depending upon the type of steel being produced and the form of the furnace charge. The best figure so far in high-speed steel qualities has been 10 per cent. There has also been a general saving of time per heat of up to 15 per cent., and it is now possible to obtain an extra heat from the furnace every shift if required. Refractory cost per ton appears to have been reduced and there is a definite saving in electrode consumption, present indications being that this is of the order of 25 per cent.

Electrode Gland

A further saving in electrode consumption will be achieved by the recent installation of a special type of electrode gland (Fig. 2). Although these glands have been on the furnace only for a very short time, there was an immediate improvement in the general shape of the electrode in the furnace, tapering being very much reduced and the electrodes remaining very close to their nominal diameter over practically the whole of their length. Picking up of the gland on the electrode has been eliminated.

The roof cooler itself is of the conventional water-cooled type resting on the roof, but a recess is machined in its upper surface. A number of machined steel segments rest loosely in this recess. The magnetic field produced by the very heavy current passing through the electrode gives rise to magnetic forces in the segments which move them towards the electrode. When the inner faces of the segments are moved inwards against the electrode, they close the gap between the cooler and the electrode and so prevent the usual upward stream of hot gases. Elimination of this stream not only reduces oxidation of the electrode, but also helps to improve working conditions by reducing fume and smoke in the foundry. The electro-magnetic forces induced in the segments are sufficient to pull the segments around the electrode, but not strong enough to prevent the electrode sliding through the segments. When the electrode is raised, the segments automatically fall away from it as the magnetic circuit is broken.

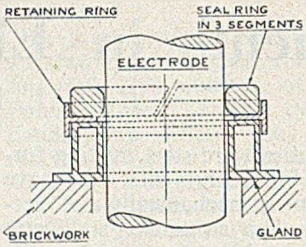


Fig. 2.—*Electrode Arrangement showing Type of Gland fitted.*

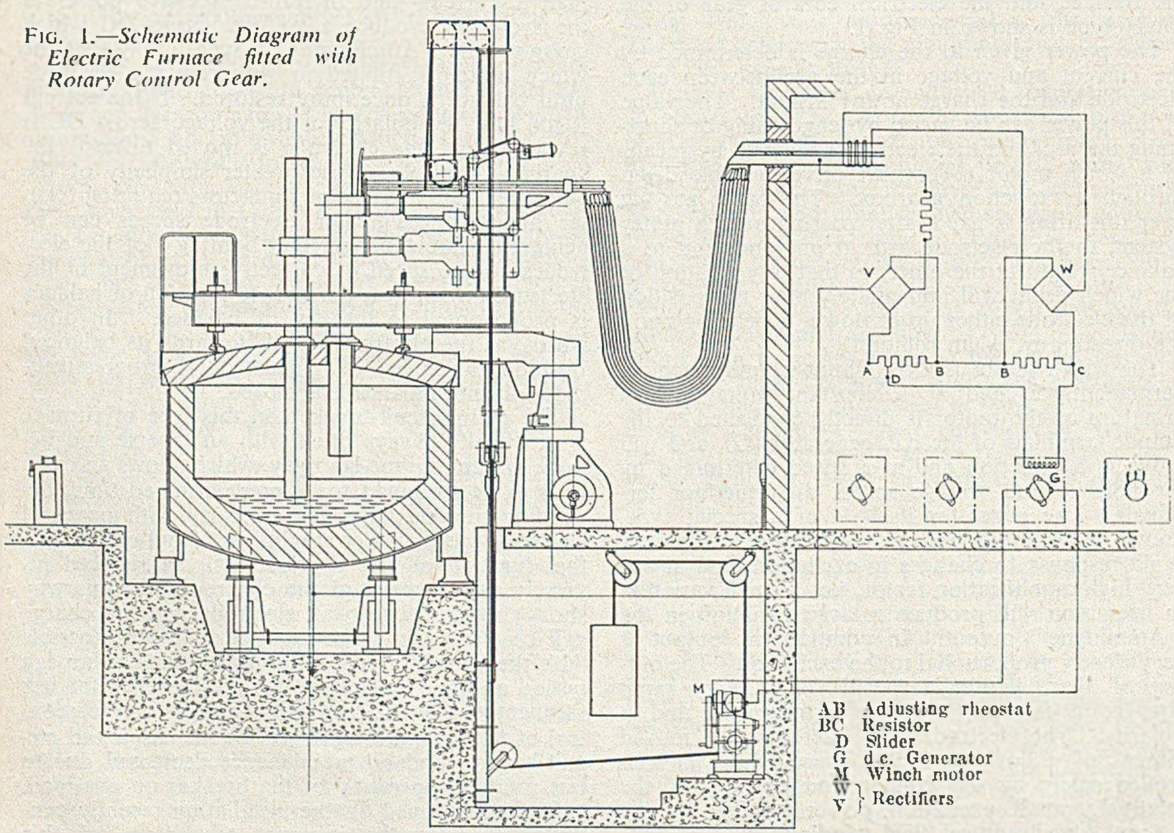


Fig. 1.—*Schematic Diagram of Electric Furnace fitted with Rotary Control Gear.*

Bureau of Analysed Samples

A GENERAL MEETING of the co-operators of the Bureau of Analysed Samples was held on November 28 at York, Dr. E. Gregory presiding; between 40 and 50 members attended. Mr. N. D. Ridsdale gave a report on the progress achieved during the last twelve years, in the course of which he said:—

In July, 1938, there were 41 standard samples available. These represented about 200 standardised elements or constituents. This year there were now 68 standardised samples available, including eight pure metals or reagents and eight spectrographic standards. These represented something like 350 or so standardised elements or constituents.

In order to get the maximum homogeneity, the Bureau aimed at getting non-curly thin machinings which remained on a 60-mesh sieve and pass through a 10-mesh. There were something like 300 particles per one gram of steel, apart from some of the smaller material between about 30- to 60-mesh size.

The Bureau continued to take precautions to remove moisture and in some cases oxygen from the containers in which the machined steel was stored—especially that which was required for determining sulphur by the evolution process. The same precaution was taken for crushed ferro-alloys.

During 1938, and again in 1947, he visited the National Bureau of Standards in America, meeting the late Dr. Lundell and Mr. Harry A. Bright, who kindly showed him the details of their process of preparing samples as well as the form of tools they used for cutting. On the whole their system was very similar to those used here.

Most metallurgists were familiar with the common applications of the standard samples, *i.e.*, mainly for the checking of routine analyses by making a concurrent determination of the standard sample with a batch of routine samples; also for making checks in a similar way on specific samples which had a composition on the borderline of a specification such as sulphur in the region of 0.050 per cent. Another use was for checking new methods of analysis. Methods which frequently appeared in the technical periodicals, often included a number of tests made on B.C.S. samples as evidence of the accuracy of the methods in question.

New Development

A more recent use which had sprung up was for the preparation of graphs for photometric methods, especially since it had been possible to have standards showing progressive increments of different elements in ascending order such as Si, Mn, Cr, Ni, Mo, etc. This was particularly useful in the case of Si where the preparation of a standard soluble silicate solution was not very simple and it was difficult to preserve the alkaline solution without its attacking the glass of the container. Some more recent methods, such as the combustion-sulphur method, were absolutely dependent upon accurate chemical standards. In a similar way, spectrographic standards were completely dependent on the accuracy of the chemical analysis of the standard rods.

There were about 1,200 laboratories using these standards in Great Britain, including government departments such as the Admiralty, Air Ministry, Ministry of Supply, universities and technical colleges, independent analysts, chemical manufacturers, engineers, founders, as well as hundreds of works-chemists in the iron and steel industry.

Analytical Accuracy

Speaking in general terms, it could be stated that the accuracy of the analyses made in connection with the standardisation had considerably improved during the last 12 years, but it was an interesting fact that though the "spread" of the figures which were accepted some years ago had been narrowed down in more recent years, in most instances the general average figures had altered very little whenever a re-analysis had been made, except in certain cases such as the determination of silicon in cast iron, where it had been found that a second evaporation did precipitate a small but somewhat significant amount of silicon, thus giving a result which was 1 or 2 per cent. (of the Si content) higher. A sample of red oxide iron ore which was analysed in 1925 showed an iron content of 58.2 per cent. The same sample re-mixed and re-analysed by the latest recommended methods by about a dozen experienced chemists showed 58.1 per cent. This was a remarkably good agreement.

The use of British Standard methods by the co-operating analysts during more recent years had led to better agreement and this was well illustrated in the analysis of the permanent magnet alloy standard (B.C.S. No. 233).

An interesting court case arose a little while ago in which the question of analytical tolerances arose. The plaintiffs had bought some phosphor-bronze to a stringent specification of a maximum of 0.01 per cent. phosphorus. The sample of the parcel had been subdivided and sent to several analysts whose results varied appreciably. The defendants had scrutinised the Certificate of Analysis of the B.C.S. Bronze "C" (No. 207) and noticed that the phosphorus content which averaged 0.55 per cent. showed a range of figures varying plus or minus 0.01 per cent. It was therefore claimed that with such a fine specification a tolerance in the figures reported should bear some relationship to the tolerance shown on the B.C.S. certificate, where chemists had reported results after carefully verifying their figures. At first it was difficult for the layman to appreciate that any tolerance should be allowed, but the impartial evidence of the certificate undoubtedly impressed the judge and contributed not a little to the dependants winning their case.

It was difficult to assess precisely how many disputes on analysis had been avoided or settled

Bureau of Analysed Samples

by the use of B.C. Standards, but there must have been a large number. He recalled in his earlier days how steelworks sometimes had the analysis of their steels checked by outside independent umpires who, in some instances, had very little experience in such work; consequently, the results were occasionally very unfortunate and large casts of steel were sometimes rejected and there were many heart-burnings. If in those days there had been authoritative standard samples such as were now available, the works chemists and the management would have regarded such samples as of immense value.

Conclusion

The last twelve years had been a period of steady progress during which some 27 new standard samples had been prepared and made available; in addition, a considerable number of renewals of existing stands had been prepared. The quality of the product and the agreement between chemists had likewise improved.

If asked what was the most important contribution these standards had made in their own field, he would say that it was that they had brought chemists all over the country into more intimate and friendly contact with one another, given them a much better knowledge of the standard of accuracy of their own work and of the methods of analysis they had been using—and most important of all—promoted a great deal of good-will. This could only have been achieved with the valuable assistance and encouragement of the large number of co-workers from different areas.

Mr. P. D. Ridsdale in a Report dealt with the more commercial aspects. During the period 1947 to 1949, no less than 1½ tons of samples were sold and this year nearly half a ton had been delivered. A change in demand had recently been noted and alloy steels and cast iron had replaced plain carbon steels as "best sellers." Bars for use as spectrographic samples were also proving popular. Twenty per cent. of the samples were exported. Appreciation was expressed of the work done and a vote of thanks was accorded by the delegates to the chairman and directors of the Bureau for their hospitality.

Imperial College Union

The 16th Annual Report of the Vacation Work Scheme shows that 515 students in science and technology during their summer vacation gained 4,413 weeks of industrial experience and earned over £20,000. Some went abroad and others were engaged in home industries. The report lists many dozens of concerns which accept students and amongst these at least 25 possess foundries. A surprisingly large number also accept overseas students—a fact which may on occasion solve a pressing problem. Mr. J. Newby, at the Imperial College, Prince Consort Road, South Kensington, is the superintendent of Vacation Studies and no doubt he will be only too pleased to handle inquiries.

Metal Chills

By "Trouper"

When a pattern is sent into the foundry carrying narrow cavities the problem facing the moulder is how to get a clean lift and at the same time ram the sand hard.

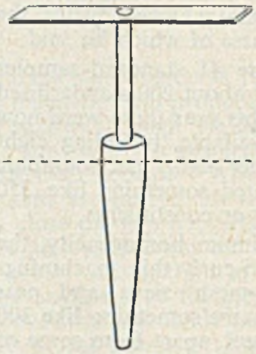


FIG. 1.—*Shaped Chill Insert used for Producing an Awkward Cavity in an Aluminium-alloy Casting.*

If the casting is to be in brass, or iron, a piece of sand core can be rammed in with the mould. This simple method will leave a clean hole in the casting and there is no risk of loose particles of sand washing in with the metal. If the casting is to be made in an aluminium alloy, a much more satisfactory job can be turned out by inserting a metal chill. This chill can be made of brass, iron, or steel, as shown in Fig. 1. The section above the dotted line is rammed in with the mould. The cross-bar, or flange, prevents the chill from falling away from the mould.

When the mould is cast, the chill will be surrounded by molten metal and this is where the trouble starts. After the casting has solidified, it will be found that the chill is firmly embedded in the casting and cannot be moved. To overcome this difficulty it is as well to make a paste of plumbago and paraffin and polish the chill before putting it in the mould. The aluminium alloy must be allowed to cool down as low as permissible and poured very slowly. If these instructions are carried out, the chill will fall out of the casting and leave a clean hole that needs no further attention.

Railways Research Organisation

The Railway Executive has decided to integrate the research facilities of the different regions into a single research department which will come into operation on January 1, 1951. The appointments have already been announced of Mr. T. M. Herbert, formerly research manager, L.M.S., to be director of research, and of Mr. E. Morgan to be assistant director. The following appointments as superintendents of the various divisions of the new department are now announced:—Mr. T. Baldwin (Engineering Division), Mr. T. H. Turner (Metallurgy Division), Mr. T. A. Eames (Physics Division), Mr. F. Fancutt (Chemistry Division), Mr. C. G. Winson (Textile Division), and Mr. M. G. Bennett (Operational Research Division).

Industrial Research

Dr. J. E. Hurst's Presidential Address to the Institute of Vitreous Enamellers

ON BEING INDUCTED to the presidential chair at the Harrogate Conference of the Institute of Vitreous Enamellers, Dr. J. E. Hurst, J.P., delivered his address on Industrial Research, in the course of which he said:—" Fused on metal " is the operative phrase in our definition of vitreous enamelling, and the implications of this phrase are almost in themselves a sufficient definition of the industry. As chairman of the Lichfield Johnson Society I may be forgiven a short digression into Johnson's dictionary. There, the verb " to enamel " is defined as " to inlay "; "to variegate with colours, properly with colours fixed by fire," and this verb is derived from an older noun " amel," which is the " matter with which the variegated works are overlaid, which we call enamelled." The use of the word " amel " is illustrated by Johnson with a passage from the great chemist, Robert Boyle's work on colours in which he tells us that the

> " materials of glass, melted with calcined tin, compose an undiaphanous body. This white amel is the basis of all those fine concretes that goldsmiths and artificers employ in the curious art of enamelling."

Fine concretes were understood by Johnson and Boyle as materials formed by coalescence and what to them was amel to us is enamel, but we still insist that enamelling is done properly with colours fixed by fire. In defining " vitreous " as glassy and to " vitrify " as to change into glass, Johnson again draws upon Robert Boyle for his illustration in the following passage from the same work on colours.

> " Upon the knowledge of the different ways of making minerals and metals capable of vitrification, depends the art of making counterfeit or fictitious gems."

Any baseness of motive implied in the use of such knowledge is quite foreign, of course, to the vitreous enameller, but it is knowledge of this kind which constitutes the science of enamelling.

Science in its widest sense means learning or knowledge, and in its more restricted sense ordered knowledge in which, as a result of observation and experiment, the understanding of phenomena is aided by the systematic or ordered classification of the knowledge gained. The pursuit of science is the pursuit of knowledge, and as an occupation this is classified and described as research.

It is interesting to speculate on the influence of the two great wars in promoting and accelerating research development during this century, and whatever views any of us hold, we cannot fail to recognise the terrific impulse to research activity following upon each of the two world wars. I am more concerned, however, in this address to direct attention to one or two aspects in connection with industrial research and its organisation, which I think are of importance to us as industrialists and which I sometimes think escape attention on the part of many of those who would plan our research organisation and training.

The various branches of science we recognise today, *e.g.*, chemistry and physics, date back to the very dawn of civilisation and are, in fact, purely arbitrary divisions in organised science barely a couple of centuries old. The scientist of the seventeenth and eighteenth centuries was neither chemist nor physicist, and their search for knowledge recognised no such arbitrary boundaries. For example, the Royal Society grew out of " an assembly of learned and curious gentlemen, of which Robert Boyle was a member, who applied themselves to the study of experimental science, or, as it was then called, the New Philosophy. As a further example, Michael Faraday's first contribution to science was an analysis of a specimen of native caustic lime; his reputation was made by the liquefaction of chlorine and gases. He discovered benzene and, although his immortal work was his experimental researches in electricity, his metallurgical researches in the field of alloy steels were of considerable significance.

Industrial Research

Industrial research, like charity, should, and does, begin at home in industry itself. In so far as it is in fact the pursuit of knowledge, I am satisfied that in some degree or other, even in the smallest unit of industry, such research is constantly in progress. This fact, I often think, is overlooked and so often do we hear the views expressed that, because an organisation is small, it either cannot afford research or cannot apply research. In a gathering such as this there must be many amongst us who can cast their minds back to their early efforts in establishing their organisations, and the hours of effort and experiment in establishing their processes and the midnight oil in study, calculating and reading and searching for information. What was this if it wasn't research? Without pausing, however, to develop these thoughts, as I am more concerned with research in larger industrial units, there are those which in their development reach a stage where some form of organisation is separately entrusted with the task of dealing with the research activities. In its simplest form we used to call it engaging a chemist and establishing a laboratory, and this was looked to for the testing and examination of our raw materials and products, the provision of all sorts of technical and scientific information and the possibility of it producing some epoch-making or certainly highly profitable discovery was an ever-present hope.

Considered in the light of the arbitrary divisions in which modern science, whether pure or applied, is taught in our universities, colleges and schools, any industry is highly complex. Our own enamelling industry is an example. A scientist in this industry must read chemistry; he cannot neglect his organic chemistry or geology or mineralogy, and in these days must have at least a comprehension of modern physics and withall must be a bit of a foundryman, metallurgist and fuel technologist. Such versatility or complexity, whichever you will, is formidable only in the light of the arbitrary divisions of modern science teaching.

Superimposed upon the development of industrial research within the units of industry, the development of co-operative research in industry has characterised the period since the end of the first world war. That the recognition of the value and the need for co-operative industrial research effort has gained in strength enormously during this period must be accepted whatever views we might have as to the manner in which such research is organised. I like to think that the formation of our technical institutes, our own, for example, during this period and others even before the first world war, in so far as they are primarily concerned with the exchange and dissemination of technical information, can be regarded as the initial steps and, in fact, part of this movement towards co-operative research effort. Financial considerations, as for example, those required in making available to industry equipment of expensive character, X-ray diffraction apparatus, the electron microscope, the mass spectrometer, vacuum fusion equipment, quite apart from the staff requirements in their operation, justify some form of co-operative effort. The ever-increasing cost of the instrumentation of a modern industrial research laboratory is now by no means the least of the problems facing the research director to-day, and it is recognised that the availability of modern instruments in industrial research is now indispensable.

I am specially anxious to direct attention to the expansion of research activities and research programmes into the fields of operational research. There was a time when research in industry was confined to the laboratory and, although any such restrictions have been disappearing steadily over the years, the real need for extension of the fields of activity, both on the part of research units in industry and the co-operative research associations, is as yet in my view only partially recognised. The yield of castings successfully enamelled, for example, is never 100 per cent. The proportion of defects may have been commercially acceptable hitherto, but under present-day conditions of labour shortages, high costs, and insistent demands and improvement in yield of even one per cent. is often of such great value as to justify tremendous effort. Such further effort and inquiry brings into prominence some process variation at some stage, and this provides just one single example of how process research and, in fact, operational research is brought within the scope of research activity.

Personnel and Training

In my view, the most important aspect of the whole subject of research in general and industrial research in particular is that of personnel and its training. Much serious consideration is being given to this matter by many committees who are planning research of all kinds. The Barlow Committee, for example, concerned itself with an estimate of the number of qualified scientists required. At the behest of the Advisory Council on Scientific Policy, the Ministry of Labour embarked upon a not very successful attempt to estimate the existing number of qualified scientists. Other surveys have been made by various educational and industrial bodies. All these surveys and attempts to provide statistical information are very necessary and very praiseworthy, but not yet has there been any attempt to assess or guide us, at least as far as industrial research is concerned, as to what are the real qualifications required.

We, as industrialists relying on research, many of us research directors, managers and leaders, and many of us actually engaged daily in research, realise as a result of experience that a whole string of University Degree qualifications in themselves—B.SC.'S, PH.D.'S, and the like, are no guide to real research ability, and it is, in fact, a disappointment that this should be so. The spirit of inquiry, initiative in inquiry, and creative ability so eminently desirable in research workers of all kinds, are so often not revealed by academic qualifications, and certainly in the field of industrial research are just as likely as not to be found in men unaccompanied by such qualifications.

Curiosity

My friend, Sir Ben Lockspeiser, in analysing the motive actuating the scientists or research worker, reaches the conclusion that in the limit he is actuated by nothing more than sheer curiosity. This curiosity on the part of the sixteenth-century scientist, Van Helmont, led him to plant a willow tree in a weighed quantity of dry earth and supply it with water only. By weighing he found at the end of five years the tree had gained 164 lb. in weight, while the earth had lost only a matter of 2 oz. For over 100 years, lack of further curiosity as to this properly conducted experiment allowed it to remain as proof that practically all the substance of the tree was water, and so it remained until Priestley showed that green plants absorb carbon dioxide from the air.

Status

The view is expressed frequently that industrial research should be carried out and expanded by industry itself, by reason of its close touch with development and production. The very same view, and for the very same reason, can be held as to the training of industrial research workers. The value of such training in industry needs no emphasis to this Institute, and the importance of this whole subject of training is accentuated owing to the shorter time a young man has available in these days for training as opposed to earning a living.

Whilst it is not difficult to agree as to the real value of industrial training, it is likewise not difficult to agree that all industrial units cannot for one reason or another provide training facilities. For this reason alone it is gratifying to industrialists to observe the attempts to further the development of

(*Continued on page* 514.)

Research—Another Viewpoint*

By J. F. Kayser, F.I.M., Assoc. Met.

The ultimate object of industrial research is to make money. An industrial research department may be a necessity or a speculation. Modern production is conducted on such a large scale that individual manufactures, be they raw castings, refrigerators, sewing machines or motor cars, cannot each be the product of an individual craftsman. A craftsman is given work of such a nature that the product of his skill enables other less-gifted workers to assist in the economic production of large numbers of high-quality castings or refrigerators or motor-cars or the like. Successful manufacture calls for the co-operation of a number of craftsmen. The word "craftsman" is, however, seldom used in these days because it has so wide a meaning. Toolmakers are craftsmen; so are many moulders and steel melters and the men who operate cold-rolling mills. One can only make the best possible use of a toolmaker, a moulder or a steel melter if he is supported by an adequate research department.

The majority of industrial organisations are expert in the sale of a limited range of manufactures and it is the duty of the production department to manufacture the required articles in the numbers called for. The hall-mark of successful mass production is uniformity. A sufficiently skilled toolmaker can produce tools that are identical in every respect, but the product from these tools, or even the product from any one of them, is not necessarily always the same and one of the main duties of a research department attached to an engineering works is to find out the cause of the variation and then to make recommendations that will improve matters. That often necessitates profound researches into the properties of metals which may call for the application of the results of fundamental research to a manufacture of such a simple thing as, say, a nail. A steel melter may experience trouble with his furnace roof. A research department equipped with X-ray apparatus may well be required to get to the cause of the trouble.

Such research departments are necessities. Their co-operation enables production to continue smoothly and often at reduced cost and increased rate. To enable them to work successfully they must be adequately housed in close proximity to the production departments they serve and a considerable proportion of the research department staff must be intimately acquainted with current manufacturing procedure. In these days, they are usually overwhelmed with work because raw materials are in short supply, and the problem of how to make do with what is available must be solved at the same time as a substitute material is being sought for.

Sometimes a research department is established for the specific purpose of developing or even discovering a new and useful product. Such a research department is definitely a speculation. It must, however, not be forgotten that a speculation is not necessarily a mad gamble. The co-operation of several research departments has given us the wonderful magnets of to-day, the latest of which, weight for weight are twenty times as efficient as the best permanent magnets of 35 yrs. ago. The original research work was put in hand as a speculation and paid a good dividend.

It is comparatively easy to evaluate the work of a research department which restricts its activities to speculative research; it may, of course, show a complete loss. A research department attached to production departments will, on the other hand, never be a complete loss, but it is difficult to evaluate its work. It is an essential service in the same way that a tool-room is an essential service. The cost of maintaining either can be easily ascertained but it is doubtful if anyone has ever been able to quote their value in £ s. d.

* At the same time as Dr. Hurst's Presidential Address (printed in the previous pages of this issue) was being prepared for press, an article on the same subject was submitted independently by Mr. Kayser. This has been printed simultaneously as it reveals other aspects.—EDITOR.

British Standards Institution

New Standard for Carban Steel Castings

A B.S. specification just issued deals with ordinary steel castings for general engineering purposes. It is a revision of B.S. 592 of 1940 and replaces B.S. 24, Part 4, Specification No. 10. The foreword reminds readers that, although the test-bars may be either attached to the casting or separately cast, the test values reported represent the quality of steel used and not necessarily those of the casting. Three grades are put forward:—A. 28 tons per sq. in. tensile; B, 32 tons per sq. in. tensile; C, 35 tons per sq. in. tensile. The chemical composition required shows the maximum percentage figures to be:—Si. 0.60; Mn. 1.00; S and P. 0.06 per cent., with 0.25 per cent. limit C for Grade A, 0.35 per cent. for B, and 0.45 per cent. for Grade C.

All castings have to be heat-treated and must give the following minimum figures:—

Properties.	Grade		
	A.	B.	C.
U.T.S., tons per sq. in.	28	32	35
Yield stress on 0·5 per cent. proof stress, tons per sq. in.	14	16	17.5
Elongation, per cent.	22	20	15
Angle of bend (minimum)	120 deg.	90 deg.	No Test

The specification details many acceptance conditions, including those involving welding. Indeed, so far as this is concerned, the procedure is set out in an appendix. In general, the specification follows the normal pattern now well established for cast products.

Monthly Information Sheet

The October information sheet issued by the British Standards Institution, 24-28, Victoria Street, Westminster, London, S.W.1, lists under "New Standards Issued," B.S. 1428, Part A1: 1950, Carbon and hydrogen combustion train—Pregl type (microchemical apparatus), 3s.; B.S. 1501/6: 1950, Steels for use in the chemical, petroleum and allied industries, 12s. 6d. This British Standard provides for a series of carbon and alloy steel specifications in the form of:—(1) Plates, sections and bars; (2) forgings; (3) castings, and (4) bars for bolting material. Under "Revised Standards Issued," there are B.S. 592: 1950, Carbon steel castings for general engineering purposes (2s.), and B.S. 673: 1950, Pneumatic tools and accessories (3s.).

Cored or Bored?

How times have changed

By J. H. Preston

1930

The foundry manager of the Cross-joint Foundry Company telephones the manager of the Hyreek Glue-works:

"Hello, George, how're things? Good! Look, George, this order you've sent us for a pipe-bend. Your sketch shows four cored holes on the flange. Let's make them solid, and drill them out afterwards. . . . OK, thanks George, see you at the match Saturday—Cheerio"!

1950

Letter from the Cross-joint Foundry Company to the Mammoth Chemical Corporation (Hyreek Glue-works Division):

Dear Sirs,—With reference to your order No. Z/X20146/8HB/606. Reference BS/ABC/DHB/641/AB. Your Drawing No. 6018321, Revision 1082/4, Pattern 8093B. This drawing shows four 1-in. dia. cored holes in the flange of the casting and we beg to suggest that production would be facilitated if this section was cast solid and the holes drilled in the course of machining. We trust you will approve this alteration and let us have your authorisation in due course.

Yours, per. pro, etc.

Letter from the Mammoth Chemical Corporation to the Cross-joint Foundry Company:—

Dear Sirs,—Our Order No. Z/X20146/8HB/606, Reference BS/ABC/DHB/641/AB, Drg. No. 6018321, Revision 1082/4, Pattern 8093B. We beg to acknowledge your request for an amendment to this design, but must point out that these castings have previously been made by the Blowhole Foundry Company, in which case a similar request was refused. Our director of research, Dr. Dimbrain, has advised that he can see no good reason for acceding to this request; however he intends shortly to visit your works in order fully to discuss all phases of the matter.

Yours, per. pro. etc.

Letter from the Mammoth Chemical Corporation (Hyreek Glueworks Division) to the Cross-joint Foundry Company:

Dear Sirs,—Our Order No. Z/X20146/8HB/606, Reference BS/ABC/DHB/641/AB, Drawing No. 6018321, Revision 1082/4, Pattern 8093B. Will you kindly inform us of the position of this order as delivery is urgently required.

Yours, per, pro, etc.

Letter from the Mammoth Chemical Corporation (Hyreek Glueworks Division) to the Cross-joint Foundry Company:

Dear Sirs,—Our Order No. Z/X20146/8HB/606, Reference BS/ABC/DHB/641/AB, Drawing No. 6018321, Revision 1082/4, Pattern 8093B. With reference to your request for an amendment to this design and the visit of our Dr. Dimbrain and four of our design experts to your works six weeks ago, we wish to state that we are unable to accede to your request and desire you to proceed with manufacture as speedily as possible. Any high-level technical assistance we can give you on this matter will be gladly forthcoming.

Yours, per pro. etc., etc.

An explosion, which wrecked a stove-enamelling plant at the works of Cox & Company (Watford), Limited, tubular steel furniture manufacturers, recently, injured four factory workers.

Diesel Locomotives

The productivity team from the Diesel locomotive manufacturing industry, which visited the U.S.A in the early part of this year, makes far-reaching recommendations in a report published last week by the Anglo-American Council on Productivity.

In an introductory statement, the team points to the enormous opportunity which was offered to the Diesel-engine manufacturing industry of America when the great and costly change-over from steam to Diesel traction was undertaken, with the assistance of the American banks, by the railways and the locomotive builders to counter the trade depression of the early 1930's. The industry quickly offered to the American railways a Diesel power unit, economical in use, easily controlled, and having a flexibility equal to the requirements of both long hauls and suburban services. As the American railways do not build their own locomotives an immense market lay open to Diesel-engine manufacturers.

In making its recommendations, the team has kept in mind two important factors that have been favourable to American manufacturers: (1) the large and "ripe" home market, and (2) one standard size of track, a generous loading gauge and heavy permissible axle loading. The British independent manufacturers cannot rely on a large home market in view of the fact that British railways manufacture their own locomotives, and are therefore forced to rely to a far greater extent than Americans on export markets, which have great variety of gauges and operating conditions. Yet the British industry will benefit from a review of American manufacturing practices.

Maintenance

Speaking on methods of reducing maintenance costs at the recent Conference of the British Institute of Management, Mr. F. L. Griffiths (works engineer, Fraser & Chalmers Engineering Works), stated that a reduction in cost of the means of production available would strike at the root of present-day problems and that the person responsible for a large contribution to this end was the works' or plant engineer. He delivered a lively defence of this hard-pressed executive, whose advice, if taken oftener, would prove a potent cutter of costs. He stressed the importance of planned maintenance and described some methods in detail, but he warned that the best plan would not work unless adequate but simple records of every part of the machinery and plant were kept up-to-date and readily available.

During the subsequent discussion, attention was called to the great savings in maintenance costs which could result from increased standardisation of design. Many speakers dealt with the problems of incentives to maintenance men, and bonuses to production units who reduced maintenance requirements. There was wide difference of opinion on both these points; many delegates felt that the difficulty of fixing responsibility for a breakdown might lead to injustice.

At the Sir John Cass College, Jewry Street, Aldgate, London, E.C.2, special courses of lectures are to be held on Thursday evenings on X-ray Crystallography (beginning January 4, 1951) and on Patents and Industrial Design Protection (beginning on January 25, 1951). A laboratory course on Solid Fuel Analysis on Monday evenings begins on January 8, 1951.

News in Brief

DOUGLAS, FRAME & COMPANY, LIMITED, are planning to extend their premises at Westbourne Foundry, Arbroath, Forfarshire.

THE COUNCIL of the Institution of Mechanical Engineers are recommending to members that Mr. Brian G. Robbins, M.SC.(ENG.), M.I.MECH.E., be apppointed the secretary of the Institution.

A SYSTEM HAS BEEN DEVISED, utilising a small machine known as the Anson "P.A.Y.E.," for simplifying the computing and recording of pay-as-you-earn income tax in relation to wage sheets and payment cards.

THE STEEL FOUNDERS' SOCIETY of America has organised a competition for the best Papers on parts or products which can be advantageously made as steel castings or new applications or uses for steel castings.

A PRODUCTIVITY EXHIBITION—the first of its kind to be held—is being organised by the Midland Regional Board for Industry, Birmingham Central Technical College, and the Central Office of Information. It will be held at the Central Technical College from December 29 to January 6.

A NEW CANTEEN, seating 1,100, at David Brown, Tractors, Limited, Meltham, near Huddersfield, was officially opened last week by Mr. David Brown, chairman of the David Brown Tractor Group. The workers had a pleasant surprise when they were told that on the opening day their meals were being given free.

ACCORDING TO THE Census of Production, the Nonferrous Metals (Smelting, Rolling, etc.) Trades acquired, during 1948, new plant to the value of £3,886,000, excluding the £263,000 they spent on vehicles. They paid out £36,614,000 in salaries and wages to 99,592 people. The value of the production was £240,824,000.

ENGINEERING ESTABLISHMENTS on Tyneside will be closed on Christmas Day and Boxing Day. Shipyards in the district will be closed on Christmas Day, open on Boxing Day, and closed on January 1 and 2. On New Year's Day in shipyards where there are engineering departments the engineers will follow the shipyard holidays.

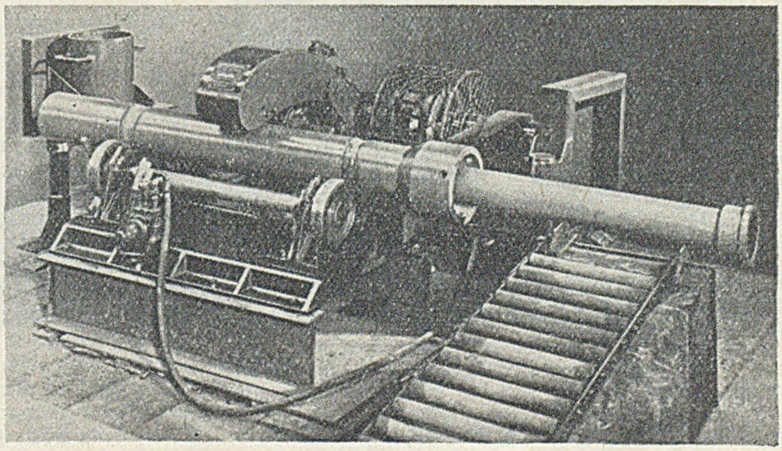
EUCLID ROAD MACHINERY COMPANY, of Euclid, Ohio, decided some time ago to set up at Newhouse Industrial Estate, Lanarkshire, a British subsidiary called Euclid (Great Britain), Limited. The firm to be established under E.C.A. guarantee will produce heavy soil-shifting machinery designed for use at airfields, on road and rail projects, and on open-cast mining and irrigation, and flood control work.

THE BESSEMER MEDAL for 1951 of the Iron and Steel Institute has been awarded to Mr. Ben Fairless, president of the United States Steel Corporation, in recognition of his distinguished services to the iron and steel industry. The Sir Robert Hadfield Medal for 1951 has been awarded to Mr. William Barr, of Colvilles, Limited, president of the West of Scotland Iron and Steel Institute, in recognition of his contributions to research in steelmaking. Dr. C. H. Desch, F.R.S., a past-president, has been nominated an honorary member of the Institute.

THE ANNUAL REPORT for 1949-50 of the Northern Industrial Group, presented at last Monday's annual meeting at Newcastle-upon-Tyne, says that, though the defence programme will certainly remove any fears of significant unemployment in the next two or three years and so give a longer breathing space than was expected, the fundamental factors of the economy of the region remain largely unchanged, and the need for their continued study is rendered no less important than in the past. The continuance of the work which the group has undertaken is urged.

NET PROFIT of the International Nickel Company of Canada, Limited, for the nine months ended September 30 last, in terms of U.S. currency, was $33,920,343, equal, after preferred dividends, to $2.23 a share on the common stock. This compares with a net profit of $26,077,125, or $1.68 a common share, in the corresponding period of last year. For the three months to September 30 last, net profit was $13,534,752, or 90 cents a share, compared with $12,056,576, or 79 cents a share, in the preceding quarter of 1950, and $5,093,708, or 31 cents a share, in the third quarter of 1949.

AFTER STANDING EMPTY since its completion two years ago, the Grenfell factory at Ammanford has been taken over by the Harden Tool & Gauge Company, Limited, Birmingham. The local employment committee has been told that the firm would be making valves for various types of machinery, such as milking machines. It is understood that the terms of the lease provide for 50 per cent. of the labour to be recruited from registered disabled men. The other 50 per cent. will be women. The unemployment figure at Ammanford is the lowest since the peak period of employment reached during the war.



Centrifugal Casting Machine shown by Constructional Engineering Company, Limited, at the recent Exhibition in Zagreb, Yugoslavia.

Steelfounders' Dinner

AS REPORTED ELSEWHERE, the annual dinner of the British Steelfounders was held last week and was attended by some 200 members and guests. The chairman, in proposing the toast of "British Industry," remarked that British industry not only supported a nation of 50 million people, but had been the mainspring by which a population of over 10 times that number had been enabled to rise to standards of living which otherwise could never have been reached. Industrialists were naturally modest, and were apt to forget that without the efficient conduct of industry of this country there would be a drastic fall in the well-being of all classes of people in the British Isles. And yet, with so much at stake, British industry had become, in these last years, the plaything of politicians. It had been bled white by taxation and emasculated by restriction. Such, however, was its resilience and the quality of its management that it still led the world in the comparative volume of its exports—one sure test of industrial efficiency.

Reviewing the industries of other countries, no one could fail to be struck with the comparisons. In no other country were the difficulties which hampered industry so great as those in ours, and in no other country were the difficulties so intelligently faced and so manfully overcome. Despite this, it had become all too fashionable to deride and revile industrialists—that herd of thoroughbreds which provided all the cream and most of the milk on which these islands subsisted. This criticism originated from a body of sincere and no doubt well-meaning people, the error of whose theories was only exceeded by their almost complete lack of industrial wisdom. One could, no doubt, take consolation from the axiom once uttered that "there is more credit in being abused by fools than in being praised by rogues."

Referring to the State monopolies, the chairman said it was a sobering and shameful fact that this country was producing 20 per cent. more coal from the mines in 1937 than to-day, despite the millions which had since been spent on mechanisation. In 1937 the country exported 40 million tons of coal a year—17 per cent. of the output. To-day it was spending hard-earned dollars in importing coal from America. We were buying coal from America at £6 a ton and exporting it abroad at £4 a ton. Despite this, a further and most important section of British industry was about to pass into the same control. This caused all men of real wisdom and industrial experience to have the gravest forebodings.

The proposed iron and steel monopoly was not a ground-nut scheme (where £30 million was lost in far, far quicker time than any industrial undertaking had ever made £30 million). It was much more serious. This was no Festival of Britain with its pre-planned loss of £9 million. This was the real lifeblood of British industry which was being tampered with. And yet the great leaders of the steel industry had been besmirched because they would not be parties to a folly from which there could be no gain and which had all the potential for great loss. All the foundry industry of this country had sympathy with them and supported their dignified conduct.

SIR ROBERT SINCLAIR, K.C.B., K.B.E., in the course of his reply, said that whilst membership of the B.S.F.A. covered something like 90 per cent. of the steelfoundries in the country, yet nearly one-quarter of the steelfounding industry was in the hands of firms due to be taken over under the Iron and Steel Act. It would be surprising indeed if there were no misgivings throughout this industry as to what the effects of this might be. Subsidised competition may be, in practice, most unlikely, but in theory it was possible; and there was nothing in our experience of nationalisation to date to support the belief that State control engendered efficiency or acted as a spur to the rest of industry.

There were enough practical difficulties arising from the general world situation, the defence programme, threats of further inflationary pressure and shortages of materials to justify the question whether, had this situation ruled two months ago, the Government would have insisted on the take-over at the earliest possible date, or whether even now they might not see wisdom and even patriotic duty in postponement of the physical take-over. He felt that, at this critical time, if the Government, without sacrifice of principles in which it believed, could postpone the taking of a step which at best must be a distraction, and at the worst the kind of upset that might arise from swopping horses in mid-stream, it would be a relief to the whole of productive industry.

Other excellent speeches were delivered by Viscount Davidson, Mr. T. H. Summerson, the vice-chairman, Mr. D. W. L. Menzies and Sir Alexander Ramsey. The guests were entertained by an exquisite pianoforte recital by Louis Kentner.

Personal

MR. C. S. GILL, managing director of Davy & United Roll Foundry, Limited, Middlesbrough, for the fifth successive year has been re-elected chairman of the Roll Makers' Association of Great Britain.

MR. J. C. H. BARROW, who has been in charge of the sodium-chlorate plant at the works of the Staveley Iron & Chemical Company, Limited, Chesterfield, has been appointed general manager of one of the company's subsidiary concerns, Philblack, Limited, Avonmouth. His great-grandfather was a founder of the Staveley organisation.

MR. MATTHEW SEAMAN, M.SC., M.I.MECH.E., M.I.B.F., has been appointed general manager of the engineering works of the British Oxygen Company, Limited, Edmonton, London. He has relinquished his appointment as director and general manager of David Brown-Jackson, Limited, Manchester, and will take over control at Edmonton on January 1.

MR. GEORGE CLARK has been presented with a bronze plaque in recognition of his lifetime of service to the Bryan Donkin Company, Limited, plant engineers, of Chesterfield. The presentation was made at an informal gathering in the works canteen on November 29. Mr. Clark, who joined the company in 1893, was managing director from 1908 and chairman from 1938 to 1949.

Industrial Research

(*Continued from page* 510)

technical or technological education as distinct from purely scientific education.

The recognition of the real economic value of technological education and the attention directed to our technical colleges has inevitably raised the question of the comparative status. There is in this country at least a suspicion of snobbery between the universities and technical colleges and a tendency to regard the latter as poor relations of the universities. Whatever might be planned or done in connection with this status, industry itself can do much in the way of providing a solution by taking its own decision to recognise equality of status in the allocation of its posts to industrial research scientists.

Book Reviews

Casting of Brass and Bronze. By Daniel R. Hull. Published by The American Society for Metals, 7310, Euclid Avenue, Cleveland, Ohio. Price $3.50.

This book is a story of the work done by the Author as assistant technical manager to the American Brass Company. Moreover, it is an interesting story, not only for those engaged in the production of brass ingots, but for all metallurgists. The book gives full acknowledgment to the research done by British workers in the field. What the reviewer liked best is the description of the hard-won fight against the theory and practice that hydrogen was "the panacea of evil" (in the mixing and melting of metals). Mr. Hull's reactions and final development of the argument against hydrogen make fascinating reading, for he possesses the style of the novelist rather than a scientific reporter.

As would be expected from such an Author, he first paints a picture of the American Brass Company's works as they were in the old days, when stress was laid upon brawn rather than technology. In the summer, the intense heat caused over-perspiration with resultant casualties, alleviated, we are told, by the local barman's foresight in adding salt to the beer, long before salt tablets were recommended by the medical profession. There are some interesting features in the chapter on melting, which opens with the phrase "since the low-frequency induction furnace has become practically universal in the brass casting industry," and this quotation is one of them. Another is the use throughout of the centigrade scale for temperature citation, which is unusual in American technology. Here are to be found all the various experiences which have their counterpart in every melting shop throughout the world, unfortunately but few are recorded, unless there is some pet theory to support. The practical findings should be most helpful to those engaged in heavy non-ferrous metal melting. The next chapter, on pouring, describes the changes that have taken place with the passage of time. Full consideration is given to mould dressings and their effect both on the ingot and the mould surface. Especially interesting are the remarks on cleaning the moulds after casting, where seemingly imperfection is the ideal.

The confessions detailed when dealing with the tin bronzes, where rolling difficulties were experienced—are such as to give fresh heart to those similarly placed. It is a matter of real interest that the Author has no hard-and-fast rules to ensure success. He has to content himself with the notion that controlled practices are responsible for much improvement. Reference has already been made to the chapter on "Oxygen, Hydrogen and Deoxidisers," and the approach to the problem reflects truthfully how old shibboleths die hard. The chapter is well garnished with personal happenings and one tells of flames 6 to 8 inches long maintained for several minutes from a 5,000 lb. copper silicon ingot. It is from a wealth of such experiences that the Author's theories are rightly based. The same story again appears under "mould dressings," where the traditional lard oil and some form of carbon were partially replaced by kerosene right up to 80 per cent. Then, when water-cooled copper moulds were introduced, a new start had to be made. In his penultimate chapter "Random Observations" the Author deals with all sorts of defects. They are described in some detail, so that where a remedy is not given, the statement is helpful, for it is axiomatic that if a problem be fully stated its solution is self-evident. In his last chapter, "Conclusions," a regrettably short one, a glimpse into the future is given. The reviewer esteems this book very highly. It is in some ways reminiscent of the great "Percy," and practical men melting and pouring brass will find inspiration in learning of other people's difficulties, which they no doubt thought were peculiarly their own.

V. C. F.

Zinc and Spelter. By J. M. Dawkins, M.A. Published by the Zinc Development Association, Lincoln House, Turl Street, Oxford.

This 36-page booklet, which is being distributed gratis by the publishers, sets out an authoritative statement as to the early history of zinc. Most of this, with the exception of Chinese work, is of the element as alloyed and not as a metal. It was not until 1743 that a method of smelting zinc was published. The history of the words pewter and spelter is as fascinating as that of zinc. There are five appendices which throw much life on the text of a subject fraught with difficulties because of the mixture of real knowledge and abracadabra which vitiates so much of the earlier writings.

V. C. F.

New Catalogues

Aerofoil Fans. So far as the foundry industry is concerned, a catalogue just issued by Woods of Colchester, Limited (an associate company of the General Electric Company, Limited), of Braiswick Works, Colchester, is most opportune, as great attention is now being given to shop ventilation. The range of plant described and illustrated is known as "Aerofoil." After a general description of the range, the question of noise is discussed, after which information is given in the field of selection. The bulk of the catalogue is devoted to the detailing by means of tables the characteristics of each unit in the range which is particularly wide. Other tables give the dimensioned shipping weight. Code numbers have been used throughout to facilitate business. It is the type of catalogue which should be within hand's reach in every buying department.

Stainless Steel Castings. Literature available on this subject is somewhat attenuated, and the issue of brochure "Stainless Steel Castings," by Paramount Alloys, Limited, Oxford Avenue, Trading Estate, Slough, Bucks, goes quite a long way towards ameliorating the situation. This company, a subsidiary of the A.P.V. Company, Limited, makes nothing other than stainless steel castings and is probably unique in this respect. The appeal of the brochure is to the technical buyer, and is made by initially outlining compositions and characteristics. Then much useful—one might also say essential—information is given on designing for castings production. The machining of stainless steel castings requires some special techniques, which are duly considered, as is welding and polishing. The catalogue, which runs to 20 pages, is nicely illustrated. It is available to our readers on writing to Slough.

Cast-iron Sticks. John Harper & Company, Limited, of Willenhall, Staffs, have just issued a catalogue of outstanding merit dealing with "Harper-Meehanite cast-iron sticks." The object—well attained—has been to give a range of the sizes available, their appearance and properties, and then to illustrate the manifold purposes to which they are put in industry. Excellent use has been made of photography, and not the least effective is the picture of sticks themselves where excellent use has been made of shadows.

Publications Received

Industrial North Staffordshire. Edited by Norman Beckett and published for the North Staffordshire Chamber of Commerce, Moorland Chambers, Trinity Street, Hanley, Stoke-on-Trent, by the Bemrose Publicity Company, Limited, of Derby and London.

In this publication the advertisements match the high level of craftsmanship attained by the editorial section and, because of the use of colour in the former, attain a brilliance usually associated with American illustrated periodicals. The Potteries is fortunate in this connection, for fine chinaware presents an ideal medium for advertisement display. The editorial section includes a well-chosen collection of local photographs and fascinating maps. Yet the area is by no means solely devoted to the production of pottery and a glimpse is given of the many industries contributing in no small measure to the general activities of North Staffordshire. The reviewer, in congratulating those responsible for the production of this 128-page book, is sure that it will give pleasure to the recipients. As an aid to future sales, it could not be bettered.

V. C. F.

Report of the United Kingdom Industrial Mission to Pakistan, 1950. Published by H.M. Stationery Office, York House, Kingsway, London, W.C.2. Price 7s. net.

The only worthwhile contribution of this Report to the businessman's requirements is the advice given as to investment of overseas capital for the industrial development of the Dominion. The report is devoid of tabular matter, but is embellished with a few "coloured cakes" and their future division—a most unsatisfactory and expensive way of statistical analysis. The reviewer, of course, excepts the high propaganda value of such a presentation for those who need pictorial rather than tabular matter for ease of assimilation. There is no thought, apparently, of establishing an iron and steel or foundry industry, except for an Arsenal. The great hydro-electrical development envisaged is no doubt being well taken care of by the Merz, Rendel, Vatten combination, and manufacturers looking for business should bear this name in mind. The reviewer cannot recommend the purchase of the Report, except by those having a special interest in Pakistan.

Journal d'Information Techniques des Industries de la Fonderie No. 19 [Special Edition]. A monthly publication. Issued by the *Centre Technique des Industries de la Fonderie*, 12, Avenue Raphaël, Paris 16. Annual subscription 1,000 frcs.

This special edition describes in detail the new central offices in the Avenue Raphaël, future plans for new central research laboratories at Sevres, and the work of the eight regional laboratories. Much information is given of the work already carried out, sometimes in the form of graphs—one of these indicates that in 1943, only 388 tests were carried out on moulding sands, whilst last year the figure rose to 9,650. It is interesting to learn that a large room has been left unfurnished so that it can house any pilot plant that may be called for. The Bulletin is particularly well edited and effective use is made of humorous sketches.

PROFESSOR PORTEVIN, an honorary member of the Institution of British Foundrymen, has been advanced to the grade of *Commandeur de l'Ordre de Léopold* and to him we tender our heartiest congratulations.

Board Changes

WILLIAM DOXFORD & SONS, LIMITED—Mr. J. G. Hugall, secretary of the company, has joined the board.

OSBORNE FOUNDRY & ENGINEERING COMPANY, LIMITED—Mr. J. H. Osborn and Mr. R. F. Horton, M.I.B.F., have been appointed directors.

FORD MOTOR COMPANY, LIMITED—Mr. E. R. Breech and Mr. A. J. Wieland have joined the board. Mr. G. K. Howard has resigned from the board.

RENISHAW IRON COMPANY, LIMITED—Dr. J. H. W. Laverick has been succeeded as chairman by Mr. J. F. Stanier. Dr. Laverick remains a director.

W. H. ALLEN SONS & COMPANY, LIMITED—Mr. Denis W. M. Allen, great-grandson of the late Mr. W. H. Allen, founder of the firm, has been appointed a director.

SCOPHONY-BAIRD, LIMITED—Mr. T. C. Macnamara has joined the board as director in charge of engineering and production. Mr. Macnamara was until recently with the B.B.C., where he was responsible for the erection of the Alexandra Palace and Sutton Coldfield television stations.

THE TEES SIDE BRIDGE & ENGINEERING WORKS, LIMITED—Mr. J. Barclay Peat, M.I.C.E., has retired from the position of managing director and has been appointed deputy chairman of the company. Mr. Wilfred L. Fletcher, A.M.I.C.E., A.M.I.STRUCT.E., has been appointed managing director.

PETTERS, LIMITED—Mr. V. J. Chalwin has been appointed managing director of the company and chairman of Bryce Fuel Injection, Limited. He is also managing director of J. & H. McLaren, Limited, and a director of a number of other companies associated with the Brush Electrical Engineering group.

Obituary

MR. ISAAC SAMUEL WANTY, 41-year-old founder and managing director of Wanty & Company, scrap merchants, of Catcliffe, Rotherham, was killed when his car crashed into a tree.

MR. W. A. KINCAID, secretary of Shanks & Company, Limited, sanitary engineers, of Barrhead, near Glasgow, died on November 28. He took an active interest in the Chartered Institute of Secretaries.

MR. W. H. WRIGHT, a former county alderman, died at his home at Leicester at the age of 86. Mr. Wright served a founding apprenticeship and in 1917 joined Wright's Havelock Foundry Company, Limited, Leicester, as manager. At the time of his death he was managing director.

THE DEATH occurred on November 30 of Mr. T. Dracup, at the age of 84. Until 1938, Mr. Dracup was a director of Samuel Dracup & Sons, Limited, Jacquard loom manufacturers, Great Horton, Bradford, a firm founded by his grandfather.

MR. JAMES SMITH, who has died at the age of 90, had for 65 years been associated with John Taylor & Company, Limited, bell founders, Loughborough, and for many years was foreman of the moulding department. In 1881 he assisted in the casting of "Great Paul" for St. Paul's Cathedral.

WE REGRET to announce the death of Mr. E. A. Carlisle, who in recent years established himself in business as a sand technologist. As it was a personal business, it now ceases to function. Mr. Carlisle came of a well-known Sheffield family of steel manufacturers, and for many years was London manager for William Cummings & Company, Limited, of Maryhill, Glasgow. Mr. Carlisle was a member of the Institute of British Foundrymen, having joined in 1927.

Raw Material Markets

Iron and Steel

The current severe weather further emphasises the precarious position of fuel supplies. But this is not the only worry of the blast-furnacemen. It is understood that the suspension of iron-ore charterings in the Mediterranean has been under discussion. In any event, tonnage is very scarce, freights are sky-rocketing, and c.i.f. cost of imported ores is adding seriously to the cost of pig-iron production. There is, consequently, little hope of increasing the number of furnaces in blast, even if the plant now in operation is kept going.

All grades of iron are eagerly sought and the aggregate output seems to fall definitely short of current requirements.

The scarcity of steel has exercised a decisive influence on the finished iron trade. It has given a big impetus to the demand for iron bars, and order-books of the finished-iron makers are now filling up very rapidly.

Re-rollers find it much easier to dispose of their output than to obtain the material necessary to keep their mills in full operation. They are offered home and export business in small bars and light sections well in excess of their production, but re-rolling materials are not coming forward as freely as they were in the summer months.

Little imported material is now available and users are constantly pressing the makers for increased deliveries of home-made billets and slabs. Even defectives and scraps command a ready sale and there is a strong market for re-rolling scrap.

For all descriptions of rolled steel products there is now a seller's market and delivery dates are lengthening. Business in black and galvanised sheets has almost reached a full stop. It is affirmed that the mills are fully booked for six months ahead. At all events, they are not prepared to take on any further commitments at present.

Rollers of plates, sections, joists, etc., have also an enormous volume of work in hand and are giving priority to home requirements.

Non-ferrous Metals

Tin consumers are taking things quietly, buying from day to day as their needs arise, for, in spite of the apparent strength of the market, there is an underlying uneasy feeling that a collapse might occur without warning. But the centre of interest is mainly fixed on the scarcity factor existing in the other non-ferrous metals, which, with the exception of lead, are facing during 1951 a period of acute scarcity.

The Minister of Supply made his promised statement in the House last Thursday, and it was such as to cast gloom over the whole non-ferrous metal industry and, indeed, over those other industries which depend on brass, copper, and aluminium products for their raw material. Looking forward over 1951 Mr. Strauss voiced a warning of continuing scarcity in zinc, copper, aluminium, and nickel. In regard to zinc the Minister forecast a cut of as much as 50 per cent. during the first quarter, although this was likely to be limited to the ordinary grade of the metal. There was mention, too, of the increasing needs of the re-armament programme. Stress was laid on this defence demand also in regard to aluminium, of which the country is not likely to dispose of more than 15,000 tons per month compared with 17,600 tons during recent months.

The rumours which have been in circulation regarding copper supplies during the coming year were resolved last week when the country was told that a severe shortage existed in certain special shapes which would affect those fabricators interested in these. Just what was meant by "special shapes" is not quite clear. As to the other types of copper, presumably wire bars, cathodes, etc., it was stated that the position was such as to make it unlikely that supplies would be available in the early months of 1951 to allow of consumption at a higher rate than in the first half of 1950, which represented a cut of about 10 per cent. on the current rate of use. Again Mr. Strauss pointed out that civilian needs would perforce have to give way to the demands of the defence programme. Whether Mr. Attlee's talks in Washington will lead to any improvement in this unfortunate state of affairs has yet to be learned. The trade will certainly not give up hope.

Metal Exchange official tin quotations were as follow:

Cash—Thursday, £1,090 to £1,095; Friday, £1,135 to £1,145; Monday, £1,140 to £1,145; Tuesday, £1,150 to £1,160; Wednesday, £1,130 to £1,150.

Three Months—Thursday, £980 to £990; Friday, £1,035 to £1,040; Monday, £1,040 to £1,045; Tuesday, £1,025 to £1,030; Wednesday, £985 to £990.

Brown Bayley's "Hiving-off" Agreement

Agreement with the Minister of Supply to "hive off" certain assets not directly connected with the process of steelmaking, and which will therefore be exempt from nationalisation, is announced by Brown Bayley's Steel Works, Limited, Sheffield. Compensation for the assets which will vest on February 15 next is to be £1,128,750 in iron and steel stock.

The company will sell to a new wholly-owned subsidiary, to be formed under the title Brown Bayley Steels, all its undertaking and assets, except:—(*a*) 260,000 £1 ordinary shares of Hoffmann Manufacturing (being 52 per cent. of issued ordinary share capital); (*b*) 2,124 shares of £100 each of Farnley Iron (being 88.5 per cent. of issued share capital); (*c*) the entire issued share capital of Brown Bayley's (South Africa) (Proprietary); (*d*) certain quoted investments with a market value at December 1, 1950, of £6,770; (*e*) an amount sufficient to enable the company to meet its liability in respect of unclaimed dividends and to pay dividends at the rate of 5 per cent. on the preference shares and 12 per cent. on the ordinary shares in each case free of tax for the period from August 1, 1950, to February 15, 1951.

Subject to stockholders' approval, the Minister will remove the name of the company from the Third Schedule to the Steel Act, and will substitute Brown Bayley Steels. Shares in the latter company will thus vest in the Steel Corporation in place of shares of Brown Bayley's Steel Works.

The compensation of £1,128,750 represents, after adjustments, a division, on the basis of relative earnings of the steelmaking business on the one hand and the above investment interests on the other, of the total compensation which it is estimated would be payable under the Act for the preference and ordinary shares of the company.

An extra-ordinary general meeting of the company will shortly be convened to put detailed proposals before shareholders. The 260,000 £1 ordinary of Hoffmann Manufacturing exempted from take-over is the entire holding in that concern of Brown Bayley's Steel Works.

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

(Delivered, unless otherwise stated)

December 13, 1950

PIG-IRON

Foundry Iron.—No. 3 Iron, Class 2:—Middlesbrough, £10 10s. 3d.; Birmingham, £10 5s. 6d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent P, £12 1s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si)—North Zone, £12 10s.; South Zone, £12 12s. 6d.

Scotch Iron.—No. 3 foundry, £12 0s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £13 2s. 6d.; South Zone, £13 5s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £13 12s. 6d.; South Zone, £13 15s.

Cold Blast.—South Staffs, £16 3s. 3d.

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, £12 0s. 6d.; Scotland, £12 7s.; Sheffield, £12 15s. 6d.; Birmingham, £13 2s.; Wales (Welsh iron), £12 0s. 6d.

Spiegeleisen.—20 per cent. Mn, £17 16s.

Basic Pig-iron.—£10 11s. 6d., all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.)

Ferro-silicon (6-ton lots).—45 per cent., £33 15s.; 75 per cent., £49.

Ferro-vanadium.—35/60 per cent., 15s. per lb. of V.

Ferro-molybdenum.—70/75 per cent., carbon-free, 8s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £100 per ton.

Ferro-tungsten.—80/85 per cent., 19s. 6d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 21s. 6d. per lb. of W.

Ferro-chrome.—4/8 per cent. C, £60; max. 2 per cent. C, 1s. 5½d. lb.; max. 1 per cent. C, 1s. 6d. lb.; max. 0.15 per cent. C, 1s. 6¾d. lb.; max. 0.10 per cent. C, 1s. 7d. lb.

Cobalt.—98/99 per cent., 15s. 6d. per lb.

Metallic Chromium.—98/99 per cent., 5s. to 5s. 3d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £30 5s. 11d.

Metallic Manganese.—96/98 per cent., carbon-free, 1s. 7d. to 1s. 9d. per lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—Basic: Soft, u.t., £16 16s. 6d.; tested, up to 0.25 per cent. C (100-ton lots), £17 1s. 6d.; hard (0.42 to 0.60 per cent. C), £18 16s. 6d.; silico-manganese, £23 19s.; free-cutting, £20 1s. 6d. Siemens Martin Acid: Up to 0.25 per cent. C, £22 4s.; case-hardening, £23 1s. 6d.; silico-manganese, £26 6s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £19 16s. 6d.; basic, hard, over 0.41 up to 0.60 per cent. C, £21 1s. 6d.; acid, up to 0.25 per cent. C, £23 1s. 6d.

Sheet and Tinplate Bars.—£16 16s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £20 14s. 6d.; boiler plates (N.-E. Coast), £22 2s.; chequer plates (N.-E. Coast), £22 19s. 6d.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £19 13s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £22 6s.; flats, 5 in. wide and under, £22 6s.; rails, heavy, f.o.t., £19 2s. 6d.; hoop and strip, £23 1s.; black sheets, 17/20 g., £28 16s.

Alloy Steel Bars.—1-in. dia. and up: Nickel, £37 7s. 3d.; nickel-chrome, £55; nickel-chrome-molybdenum, £61 13s.

Tinplates.—I.C. cokes, 20 × 14, per box, 41s. 9d., f.o.t. makers' works.

NON-FERROUS METALS

Copper.—Electrolytic, £202; high-grade fire-refined, £201 10s.; fire-refined of not less than 99.7 per cent., £201; ditto, 99.2 per cent., £200 10s.; black hot-rolled wire rods, £211 12s. 6d.

Tin.—Cash, £1,130 to £1,150; three months, £985 to £990; settlement, £1,140.

Zinc.—G.O.B. (foreign) (duty paid), £151; ditto (domestic), £151; "Primo Western," £151; electrolytic, £155; not less than 99.99 per cent., £157.

Lead.—Good soft pig-lead (foreign) (duty paid), £136; ditto (Empire and domestic), £136; "English," £137 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, all English destinations, £170 7s. 6d.; rolled zinc (boiler plates), all English destinations, £168 7s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £139 10s.

Other Metals.—Aluminium, ingots, £120; antimony, English, 99 per cent., £250; quicksilver, ex warehouse, £36 10s. to £37 10s.; nickel, £386.

Brass.—Solid-drawn tubes, 21⅝d. per lb.; rods, drawn, 28¼d.; sheets to 10 w.g., 26d.; wire, 26⅛d.; rolled metal, 24¾d.

Copper Tubes, etc.—Solid-drawn tubes, 23¼d. per lb. wire, 226s. 6d. per cwt. basis; 20 s.w.g., 254s. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £225 to £245; BS. 1400—LG3—1 (86/7/5/2), £235 to £255; BS. 1400—G1—1 (88/10/2), £300 to £335; Admiralty GM (88/10/2), virgin quality, £310 to £335, per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £330 to £350; L.P.Bl. £240 to £260 per ton.

Phosphor Bronze.—Strip, 34d. per lb.; sheets to 10 w.g., 35⅞d.; wire, 36d.; rods, 33½d.; tubes, 38¾d.; chill cast bars: solids, 34½d., cored, 35½d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Ingots for raising, 2s. 2¾d. per lb. (7%) to 3s. 1½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 2s. 8¾d. (7%) to 3s. 7½d. (30%); to 12 in. wide × .056, 2s. 9d. to 3s. 7¾d.; to 25 in. wide × .056, 2s. 11d. to 3s. 9¾d. Spoon and fork metal, unsheared, 2s. 5¾d. to 3s. 4½d. Wire, 10g., in coils, 3s. 2¼d. (10%) to 4s. 1d. (30%). Special quality turning rod, 10%, 3s. 1½d.; 15%, 3s. 5¾d.; 18%, 3s. 10d. All prices are net.

New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

S. WHITEHEAD (IRONFOUNDERS), 13, Balfour Road, Broadheath, near Altrincham—£3,000.

LAYTON & COMPANY (ENGINEERS), 567-587, Barking Road, East Ham, London, E.6—£10,000. E. J. & A. H. Layton.

F. L. LAWRENCE (ENGINEERS), 35, Prince of Wales Road, Norwich—£5,000. F. L. I. Lawrence and H. Richardson.

PETER HOOKER, 8, Chingford Mount Road, London, E.4—Mechanical engineers, etc. £5,000. P. B. Downes and E. R. Bartlett.

GOWERTON IRON & STEEL (SUPPLIES)—£2,000. W. B. O. Griffiths, 20, Firs Street, Dudley (Worcs), subscriber.

SLATER & COMPANY (LIMESTONE), Caulkland Quarry, Thornton-le-Dale, near Pickering (Yorks)—£10,000. A. Slater and G. W. Taylor.

S. MOORHOUSE & SON, Hillhouse Smelting Works, Hillhouse, Huddersfield—Metal merchants and refiners. £10,000. S. and G. C. Moorhouse.

STEVENS BROS. (CRADLEY HEATH), Newton Lane, Cradley Heath (Staffs)—Hollow-ware manufacturers. £30,000. G. H. and E. E. Stevens.

HAPSTEAD ENGINEERING COMPANY—£10,000. G. C. Henley, New Croft, Little London, Ardingley (Sussex), L. Fellows, and R. D. Tumman.

SECRETANS, 2, Grand Avenue, Southbourne, Bournemouth—Machine-tool makers, etc. £5,000. N., E. K., and J. E. Secretan, and H. Lilley.

BERRY & FOSTER (REPAIRS), Stoney Lane, Ovenden, Halifax—Machine-tool makers and engineers. £6,000. T. Berry, senior and junior, and H. Foster.

FONADEK (BRANSON), 192, Corporation Street, Birmingham, 4—Manufacturers of electrical and other apparatus. £5,000. J. C. S. and E. F. M. Branson.

FOUR OAKS SPRAYING MACHINE COMPANY, Four Oaks Works, Belwell Lane, Four Oaks, Sutton Coldfield—£20,000. W. C. G., L. B., and L. Ludford.

DAVID BROWN TRACTORS (ENGINEERING), Meltham Mills, Meltham, Huddersfield—To acquire the undertaking and certain of the assets of David Brown (Tractors), Limited, etc. £500,000.

Forthcoming Events

DECEMBER 18

Sheffield Society of Engineers and Metallurgists

"Some Technical and Economic Aspects of Industrial Research," by D. A. Oliver, M.SC., F.INST.P., F.I.M., at the Royal Victoria Station Hotel, Sheffield, at 6.15 p.m.

Institution of Works Managers

Glasgow Branch :—"Budgetary Control," at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, at 7.15 p.m.

DECEMBER 19

Institution of Incorporated Plant Engineers

Glasgow Branch :—"Refrigeration and Some Industrial Applications," by P. D. Cowell, M.INST.R., at the Engineering Centre, 351, Sauchiehall Street, Glasgow, at 7 p.m.

MORE THAN HALF the 100 men who were discharged from Fletcher Houston & Company, Limited, founders, of Dudley Port, Tipton, for taking part in a strike over a closed-shop dispute have been reinstated at their own request. This was announced by the firm on Monday of this week, when it was added that production should be back to normal by Wednesday.

THE LATEST ISSUE of *Bradley's Magazine* (the house organ of Bradley & Foster, Limited) reaching this office discloses that Ni. Resist treated with 1 per cent. mischmetall (cerium alloy) before casting yields an iron with over 2½ times the tensile strength and double the transverse strength of the standard material. The improvement is brought about by a change from flake to nodular graphite, the change however being far from complete. Ni. Resist treated with magnesium/nickel alloy gave only a small improvement in mechanical properties.

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

FOUNDRY FOREMAN (38) seeks similar position, Lancashire area. 10 years' executive experience jobbing and repetition. All types iron, including Meehanite and non-ferrous metals. Also rate-fixing and estimating experience.—Box 314, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (45), 25 years' experience light castings. Repetition specialist, take full control. Shortly available to take up post (Black Country district only), preferably with small foundry wishing to progress. Moderate salary, plus results.—Box 400, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN, practical man, able to price, cost and estimate, control and train labour and get results. Age 45. Consider post Midlands. Available short notice. Salary plus bonus basis. Energetic, conscientious and reliable. Excellent record. Desires join small foundry.—Box 402, FOUNDRY TRADE JOURNAL.

METALLURGIST, University degree, linguist, experienced in steel, iron and non-ferrous foundry management, sand and furnaces control, knowledge of welding, electroplating, anodising, metal analysis, desires progressive position. Home or overseas.—Box 416, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

YOUNG FOUNDRYMAN wanted for routine technique control by Birmingham gravity die-casting and sand foundry. A basic training in pyrometry and some metallurgical knowledge advantageous. Good future possibilities for a suitable man.—Box 380, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN wanted for establishment in West of Scotland; must be experienced in hollow-ware and general iron foundry work.—Box 406, FOUNDRY TRADE JOURNAL.

EXCEPTIONAL opportunity occurs for Gentleman (preferably with practical or executive experience) to take over whole or part of Managing Director's holding in Foundry (Grey Iron, general and repetition, non-ferrous) in West Bromwich district; commodious premises, long lease, going concern, full order book; capacity 20/30 tons weekly; present output 8 tons, ample scope; capital required £3,000-£6,000; room for development and extensions. A rare opportunity, as working capital is required for expansion.—Apply, first instance, "ACCOUNTANT," Box 398, FOUNDRY TRADE JOURNAL.

COMPANY of International repute invite applications from FOUNDRY TECHNICIANS/METALLURGISTS who think they have a flair for selling. Some general knowledge of foundry operations essential as service work links up with an extensive range of chemical-metallurgical products. Preferred age group 25/40. Although not essential it is desirable applicant should possess a car or have ability to drive. We are only interested in keen, enterprising hard workers who are willing to submerge other interests for a tough but fascinating job. The provisional areas are Scotland, Yorkshire and South Wales. Reply should be as explicit as possible and interviews probably given in the particular area.—Box 358, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

REQUIRED IMMEDIATELY.—MOULDERS for H.W. Connections, and MOULDERS and MATES for 6 ft. and 9 ft. lengths of 4-in. hot water pipes. Piece work rates.—Apply C. P. KINNELL & COMPANY, LTD., Thornaby-on-Tees, Stockton-on-Tees, Co. Durham.

FOUNDRY MANAGER required for expanding medium size Newcastle Iron Foundry. Age about 35. Should be fully conversant in modern methods of quantity production for high grade engineering and motor cylinder castings. Must have knowledge of Cupola, Sand Control and Metallurgy, and capable of utilising and training "green" labour. Excellent prospects for energetic man. Write, giving full particulars, salary required.—Box 386, FOUNDRY TRADE JOURNAL.

FOREMAN required, to supervise production at Grey Iron Foundry. Age 30-40. Sound knowledge of floor, machine and mechanised production essential. Applicant must have proved himself in similar capacity and should preferably have experience of cupolas, metal and sand control.—Write, stating age, experience, and full history of employment, to JONES & ATTWOOD, LTD., Stourbridge, Worcs.

FERROUS and Non-Ferrous Foundry requires MOULDERS and TRIMMERS. Only skilled jobbing moulders need apply. — PLANT MACHINERY & ACCESSORIES, LTD., 136-140, Bramley Road, W.10. Ladbroke 3692.

METALLURGIST required for foundry of large Sheffield Steelworks. Previous experience of steel foundry practice essential. University degree or equivalent desirable.—Applications to Box 408, FOUNDRY TRADE JOURNAL.

FOUNDRYMAN required in Birmingham, to take charge of small Sand Production Foundry in Aluminium and Copper-base Alloys. An ability to develop productivity methods and a well grounded experience in moulding and alloy techniques is essential.—Box 382, FOUNDRY TRADE JOURNAL.

SALESMAN for an Aluminium, Iron and Non-ferrous Foundry, with connections. After ability proved partnership would definitely be offered. Opportunity for a real live foundryman who wishes to earn over four figures. Foundry already established.—Box 404, FOUNDRY TRADE JOURNAL.

FOREMAN COREMAKER required for Jobbing Grey Iron Foundry, castings up to 8 tons, in South Midlands area. Must possess all qualities for controlling men.—Apply in first instance to Box 388, FOUNDRY TRADE JOURNAL, stating age and experience.

ESTABLISHED EQUIPMENT.—Manufacturers require experienced FOUNDRY FOREMAN; control small modern mechanised foundry for light grey iron castings. Capable expansion. Good prospects. S.W. Lancs.—Box T833, LEE & NIGHTINGALE, Liverpool.

SITUATIONS VACANT—*Contd.*

REPRESENTATIVE required for Scotland for sale of well-established and advertised range of Core Binders. Payment by salary, expenses and bonus.—Apply, giving fullest particulars of age, experience, salary required, etc., to Box 368, FOUNDRY TRADE JOURNAL.

SMALL Iron Foundry in North-East, approx. 5 miles Darlington, producing Grey Iron Castings for the Machine Tool and Valve Trade, also general jobbing work, require experienced FOUNDRY FOREMAN. Conversant with this class of business. It is possible that a house could be provided in a very short time for suitable applicant. Only top class man who feels he can improve existing conditions need apply. Please state experience, age, and salary required.—Box 378, FOUNDRY TRADE JOURNAL.

MOULDER required for Non-ferrous Foundry, Middlesex area. Accustomed to jobbing work up to a £100. Good prospects for right man.—Box 364, FOUNDRY TRADE JOURNAL.

TECHNICAL SALES REPRESENTATIVE required for East London and East Anglia. Sound engineering background and knowledge of metal forming processes (casting, stamping, etc.) desirable. Car owner preferred. Good prospects with growing organisation.—Box 414, FOUNDRY TRADE JOURNAL.

WANTED.—FURNACE MAN, conversant with the melting of scrap metals in large reverberatory furnace, for Australia. Salary according to qualifications. Passage paid, also for family.—Apply Box 362, FOUNDRY TRADE JOURNAL.

VACANCY for young man, age 25/30, to be trained for above situation in large modern foundries in Yorkshire, producing high-class steel, iron and non-ferrous castings. Knowledge of foundry practice essential. Good prospects for person with ability.—Apply, giving details of age, education, salary, etc., to Box 346, FOUNDRY TRADE JOURNAL.

WANTED, FOUNDRY FOREMAN, for medium and large plate moulding work for large engineering works. Manchester area. Able to control semi-skilled labour, 5-day week, good welfare facilities.—Write, stating age, experience, and salary required, to Box 392, FOUNDRY TRADE JOURNAL.

YOUNG METALLURGISTS, preferably experienced in the casting of heat-resisting steels and alloys, required for Foundry development work in Midlands. Sound metallurgical training to at least H.N.C. Metallurgy or A.I.M. standard required. State age, education and experience to Box 410, FOUNDRY TRADE JOURNAL.

WANTED. — STEEL FOUNDRY MANAGER for Foundry (Huddersfield district). Specialising in pressure castings.—Reply, stating full details of previous experience, Box 744, FOUNDRY TRADE JOURNAL.