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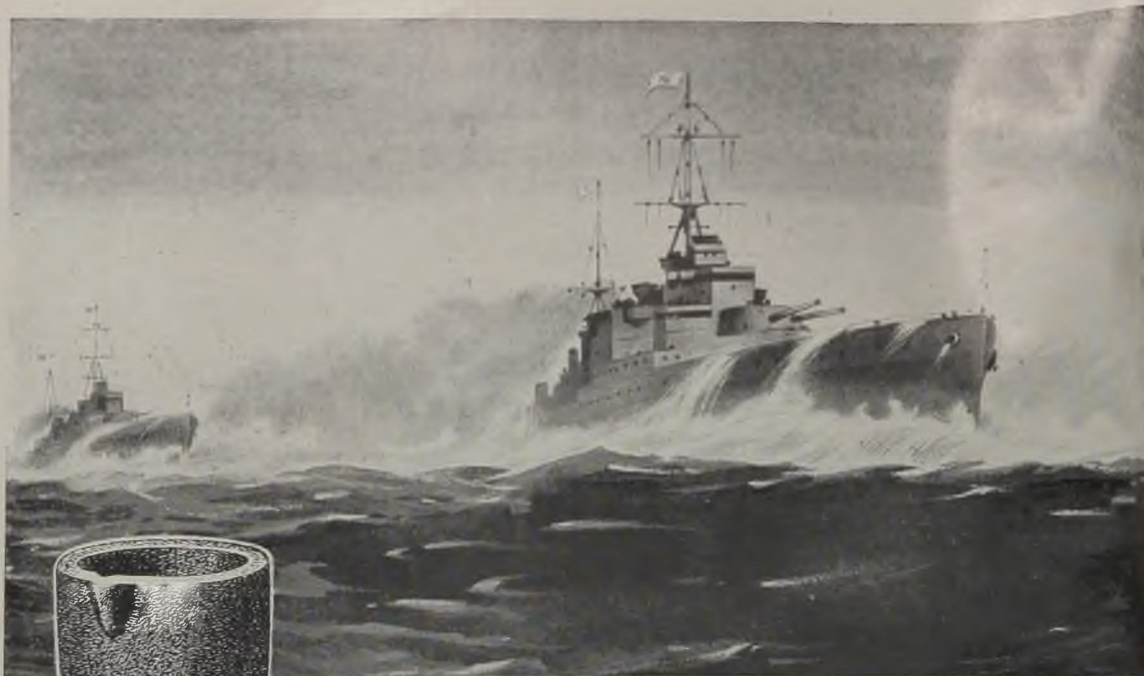

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Vitreous Enamelling

There was a feeling of optimism at the tenth annual conference of the Institute of Vitreous Enamellers. Though there are about 120 firms in the country engaged in this trade, a great expansion is confidently expected in the post-war era. The new president, Mr. J. W. Gardom, is well known for his ability to inject enthusiasm into technical institutes, and a fundamental for a progressive industry is the existence of an active association where its executives can discuss their problems and record their research work. A second essential is a research organisation, and there is some hope that this too will be established. The retiring president, Mr. W. H. Whittle, received many eulogies on vacating the chair. He certainly merits the thanks of all engaged in the industry for his work in creating a sense of co-operative interests and responsibility amongst enamellers.

There was some criticism of the ironfoundry industry, as some of the castings it now supplies are not too well suited for enamelling. The answer is that it is unable under present conditions to obtain the type of raw materials which are best suited for the production of castings for this purpose. Moreover, like the old-fashioned foundryman who asserted that he would and could make a good casting from any type of pattern, so too there are a few enamellers who pride themselves on their ability to enamel any iron casting they may receive. Both do incalculable harm to their respective industries. If a foundryman has to make castings for enamelling from an all scrap mixture, let him melt with a very soft blast. A Paper from Mr. G. E. Charlish and Mr. E. J. Heeley, I.C.I., showed how the chemical industry had been suffering from the breakdown of the enamel in glass-lined apparatus, utilised in connection with acids. But the authors showed how, by the use of a high-frequency "electric needle," weak spots could be discovered before the apparatus was put into service. It seems to us essential that the bath manufacturers and others making a similar class of goods must arm themselves with this "needle."

A feature of this conference was the exceptionally large attendance, especially of the suppliers of the raw materials. These interests are rightly anxious to learn of both the commercial prospects and technical advances in order that they may be in a proper position to give adequate service as soon as the rehousing schemes—priority number two—get under way. Houses are useless without kitchen and bathroom fittings, and the amount of material for these two essential purposes is now totally inadequate. The co-operation between the suppliers and the enamellers is commendably close and helpful. The research work for the industry is largely done by the former. The pressing need for fundamental work, however, demands that there must be full collaboration by everybody. Its consummation will result in expanding the industry and thereby the suppliers will benefit. The success of the conference was due in no small measure to the hard work put into its organisation by the honorary secretary, Mr. W. Thomas.

NOTES ON FLOW MEASUREMENT

The first issue of the sales bulletin of the Metronic Instrument Company, Limited, 196, Grove Lane, Smethwick, Staffs, opens a series of articles describing in simple language the fundamentals of positive and inferential flow measurement of liquids and gases. These articles are primarily intended for the benefit of the man whose duties include flow measurement. The information given enables the reader to be able to make reliable flow computations which satisfy the British Standard Specification on Inferential Flow Measurement; and also it clarifies some of the difficulties surrounding liquid measurement with positive and inferential meters.

Contents

CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

THE FOUNDRY INDUSTRY

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Being a reader of your journal for some 30 years, I am always interested in the subject that crops up again and again, referring to the right type of boy who should make the foundry his career.

I think Mr. Butters, in his recent presidential address, put it very nicely, so far as qualifications of the boy were concerned. But I would like to reverse it with this remark, *That it should be the right type of foundry.* Now, I stress this point, being a moulder with a wide and varied experience in handling boys in foundries. Many of these boys have left the industry and taken up more congenial work. Why? Because some of the foundries are more like pig-sties than workshops. Many have no separate rooms to change and wash in before leaving work, and, again, boys are seldom encouraged to apply themselves to the technique of the craft in such a way that they can solve problems that continually arise.

I have known in my experiences a fitter to be appointed the foundry foreman. He, by the way, generally had to rely on the leading hand to carry him through. Many patternmakers ultimately become foundry managers. This should not be. Naturally, some readers will reply that the moulder is incapable of running it successfully.

In brief, we can get the right type of boy if we train him and give him suitable work to do, whilst at the same time giving the foundry improved lighting, heating and ventilation. Moulding is a highly skilled trade and should be recognised as such. The foundry needs brains and skill, so it is up to the foundry owners to make the shops fitting places in which to work, and then perhaps this continual complaint of the absence of suitable boys for the foundry will disappear.—Yours, etc.,

W. T. BORSBERRY.

"Oke-Ira,"
Overstone Heights,
Northampton.
November 19, 1944.

[We, too, can look back over long years, but we have noted a slow but continuous improvement in the general level of "housekeeping." We agree that the pace must be accelerated in order to compete with other industries.—EDITOR.]

Die Steel

Mr. S. U. Siena, of the Sperry Gyroscope Company, in a Paper which he presented to the American Foundrymen's Association, recommends the following composition as being well suited for dies for cold chamber high-pressure die-casting machines: C, 0.35; W, 5.0; Cr, 1.0; Mo, 1.0; heat-treated to a Brinell hardness of about 450. In some cases an 18-4-1 high speed steel has been successfully used.

NOTES FROM THE BRANCHES

Wales and Monmouth Branch.—On November 4, members of this Branch were invited to visit the hematite iron ore mines at Llanharry, Glamorgan, owned by the Glamorgan Hematite Iron Ore Company, Limited. The members were met at the mine by Mr. W. C. Barnett, director, and Mr. Blackburn, manager, who headed the party of guides, who each took care of nine visitors. After a tour of the surface installations, including the power house and winding house, each group descended the mine, which is approximately 300 ft. deep. Here the first object of interest was another engine and pump plant. Water was present everywhere, and in order to keep working this is pumped to the surface at the rate of 300,000 galls. per hr.

The company were entertained at tea in the works' canteen, and a film on the manufacture of pig-iron was projected, thus competing a study of the first two processes in the production of iron. At the conclusion, Dr. Brynmor Jones proposed, and Mr. H. J. V. Williams seconded, a vote of thanks to Mr. Blackburn, Mr. Barnett and the firm for their generous hospitality, which was carried with acclamation. Mr. Blackburn replied briefly, expressing his pleasure at being able to afford members of a kindred industry the opportunity of extending their knowledge of a primary branch of metallurgy.

South African Branch, Cape Town Section.—The August monthly meeting was addressed by Mr. L. Rowley. Under the title of "The Cleaning and Fettling of Castings," the lecturer covered the subjects of rough fettling, grinding, removal of gates, shot blasting and wet sand blasting, dust extraction and collection. A short discussion followed the presentation of the Paper, in which Mr. Batchelor, Mr. Storkey and Mr. Syborn participated.

U.S. FOUNDRIES TO BUY NEW PLANT

The 16th annual meeting of the [American] Gray Iron Founders' Society—the employers' association—was held at Cincinnati on October 11. The luncheon session was addressed by Mr. Frank G. Steinebach, Editor of "The Foundry," who said that 64.1 per cent. of the approximately 2,800 foundries in the United States have laid plans to purchase new equipment in varying amounts after priorities are lifted. He added that 12.6 per cent. have in mind melting furnaces, 39.4 per cent. moulding machines, 30.7 per cent. material handling equipment, 25.5 per cent. blast cleaning equipment, 19.9 per cent. core machines, 16.5 per cent. mould and core ovens, 7.2 per cent. heat-treating furnaces, 21.2 per cent. shake-out equipment, 17 per cent. dust arresters, 25.4 per cent. sand-preparation equipment, and 24 per cent. X-ray equipment. Mr. Steinebach said that 90.2 per cent. of all the metal-working companies in the United States use castings and, of this percentage, 80.7 per cent. use grey iron.

A PLEA FOR THE EXTENSION OF RESEARCH

MR. T. TYRIE'S PRESIDENTIAL ADDRESS TO SCOTTISH FOUNDRYMEN

With the favourable turn of events in the European situation our thoughts, not unnaturally, are dwelling largely on the re-establishment of conditions more acceptable to a democratic, freedom loving, and industrious nation. It requires but little effort of thought to appreciate that the drain upon our national resources which has resulted through the waging of two long wars within the comparatively short period of 25 to 30 years, has seriously upset the economic balance which has been largely in our favour since Britain first assumed the place of leading industrial nation in the world. Only the most optimistic can imagine our ever recapturing that position of industrial pre-eminence, and the more logical view of the post-war position points to the need for our waging a full scale industrial battle if we are to hold a place in the markets of the world. The truth of this may be more readily appreciated from consideration of the economic balance as it stood prior to the present war.

According to the London Chamber of Commerce, the annual value of this country's imports was of the order of £900,000,000, of which £400,000,000 was represented by foodstuffs, £250,000,000 by raw materials, and £250,000,000 by manufactured or semi-manufactured goods. Visible exports, mainly of manufactured goods, met £500,000,000 of this import bill, and the balance of £400,000,000 was paid for from interest on foreign investments, shipping insurance and other services rendered to foreign countries. It is well known that these foreign assets have been largely used up or lost during the present war, and the London Chamber estimates that for this country to enjoy imports to the same value as formerly our export trading will require to be expanded by at least another £200,000,000, to a minimum total of £700,000,000 of manufactured goods. In a world which is becoming increasingly industrial this is no easy matter. Further, the demand for foodstuffs and raw materials is steadily increasing throughout the world, and must result in a substantial alteration in the price ratio between these and the manufactured goods which form the bases of our export, with advantage to the former. The net result of this tendency is that we are faced with an increased bill for our imports, unless we can expand our own food and raw materials production, and even with that, to meet the cost of a smaller tonnage of imports, our exports must be increased substantially. In the home market our own products must likewise be stepped up, and we must make greater use of our limited range of raw materials.

In a world already marching to a high level of industrialisation, we cannot afford to be behind. Obsolete products must be ruthlessly scrapped, wares must be made more attractive, more varied and better value for money, and this cannot be done without an effort, without mobilising all the available resources of the country. Among these resources our capacity for research ranks high, but apart from the impetus of war, it is to our shame that in this field of research we have been far behind other highly industrialised nations such as the U.S.A., the U.S.S.R. and Germany. Emphasis must be laid on the fact that the unfavourable contrasts are not due to any lower standard of British science. The last war and this one have conclusively proved that the inventive genius and scientific knowledge of our people are second to none, and given the same opportunity in peace as in war British discovery and invention in the future will play as predominant a part in the rebuilding of this war-shattered world as it played 150 years ago in laying the foundation of the material civilisation of the modern world. It is with this conviction that I am bold enough to direct your attention to the position of research in relation to industry and to endeavour to awaken in you a keener interest in its application to the needs of our own particular field.

Organisation of Research

Research in Great Britain is carried on in five groups of establishments:—Laboratories of the Universities and technical colleges; research stations of the Department of Scientific and Industrial Research (Agricultural and Medical Research Councils); collective research associations supported partly by industry and partly by grants from the D.S.I.R.; research laboratories of private firms, and research establishments of the fighting Services.

Broadly speaking, research is pursued with three main objects:—(1) The increase of natural knowledge for the sake of knowledge, which may be regarded as pure research; (2) the elucidation of major problems affecting a whole industry, described as fundamental research; and (3) the elucidation of problems connected with individual products or individual firms, referred to as specific research. The industrialist cannot afford to neglect any of these aspects.

Many of our industries have sprung from or derived immense impetus from the results of pure research carried out for the most part in the laboratories of Universities and technical colleges. At any moment a new industry may be born there which will meet a new human need, and it is to the University and college research laboratory that we must look for the men required as leaders of industrial research. The fact that pure research has no particular industrial objective and offers no immediate financial appeal to individual industries or firms makes it an enterprise which has called forth little industrial support, and one which for the most part is financed by the Government. That this should be a national liability is no doubt perfectly sound; nevertheless, industrial support in the form of endowed Research Fellowships would

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be a welcome addition. The present annual Treasury grant to the Universities for all purposes is only £2,250,000, out of which the Universities allocate a portion for research.

For financial reasons, the Universities and technical colleges are obliged to give greater consideration to that part of their function which consists in teaching and the number of students seeking instruction is largely the factor which determines the size of the laboratories, and the staff employed. Taking into consideration the fact that the Universities are the bodies largely entrusted with the important task of pursuing pure research, it seems fitting that they should be in a position to maintain a larger staff than at present of graduates and skilled technicians, and it is encouraging to note that the Parliamentary and Scientific Committee has recommended the expenditure of a further £10,000,000 over the first five post-war years for the purpose of equipping and enlarging University research laboratories.

Staffing Problems

The provision of an adequate supply of fully qualified men and women for industrial research organisations is also of the highest importance, hence the teaching side cannot be neglected in any consideration of the position of our Universities and colleges. The Government realised this aspect before the war and envisaged a programme to increase the provision of technical and art colleges and to expand and bring up to date those already in existence, at an estimated cost of £12,000,000. In the more recent White Paper on educational reconstruction it is proposed to spend an additional sum of £100,000 on the development of technical education in the fourth year of the reorganisation of the educational system in England, and it is to be expected that any forthcoming educational reconstruction in Scotland will be likewise considered. The decline in interest in our present apprenticeship system demands that something should be done to restore the status of the artisan and technician, if for no other reason than to ensure that no man shall pose as such who has no real qualifications for the work he undertakes, and this can be contributed to by a widespread system of technical education of certified standard, the onus for which must fall on our Universities and technical colleges.

Fundamental and specific research together constitute the field of industrial research and can scarcely be considered separately. Admittedly it is with fundamental research that the laboratories of the D.S.I.R. and of the various research associations are primarily concerned, whilst the laboratories of private firms are responsible for most of the specific phase. Nevertheless, a considerable number of investigations of interest to private firms are conducted by the former bodies, whilst much information of a general character has been disseminated from private laboratories and made available to one or more whole industries.

A Plea

The larger industrial organisations have for many years maintained their own research and development laboratories staffed by scientific personnel whose efforts have been directed to overcoming manufacturing difficulties, improving existing processes, inventing new methods of manufacture, producing new types of goods and not infrequently entirely new substances. It is not easy to assess the value or the national importance of the work done by individual firms, since neither the money spent nor the numbers employed are a sufficient indication. Many important results have accrued from the work of small groups of men with but scanty resources at their command, whilst large sums are not infrequently spent with but little success. The Industrial Research Committee of the Federation of British Industries has, however, instituted inquiries covering a wide area and a large number of firms, with the object of forming an impression of the scope of research by individual firms, and the results of these inquiries, published in October, 1943, are interesting.

Quoting from the F.B.I. Report: "The global results of the inquiry show that, in 1930, 422 firms were spending £1,736,000 on research and development; in 1935, 484 firms were spending £2,696,000, while in 1938 566 firms were spending £5,442,000. Scientific graduates and other technically qualified personnel employed wholly or mainly on research and development in 1930 by 384 firms numbered 1,381; similar personnel employed in 1935 by 432 firms numbered 2,566, while in 1938 the research personnel of 520 firms numbered 4,382. These results do not by any means cover all firms engaged in research and development, nor has every firm making a return been able to show the full extent of its research and development expenditure. Thus the figures considerably understate the true position. Owing to the incomplete nature of many of the returns, no attempt should be made closely to compare one year with another."

Although some of the work carried out by individual firms is of fundamental character, the greater proportion is necessarily of the specific type concerned with the firm's day-to-day problems. Specific research should yield solutions capable of immediate industrial application and of the greatest financial advantage to the firm; consequently, it is the type of research for which money is most readily available. Naturally, the larger industrial units have found it easier to bear the cost of maintaining their own research departments, but even among smaller firms, routine testing laboratories have become a necessity, especially during the war years, and these might well form the nucleus of a useful research department, in firms prepared to adopt a long-view policy. Hardly any of the firms who already possess research laboratories confine their expenditure on research to their own establishments. Generally speaking, such firms are also members of the research associations and make the most use of the results obtained therein and in the laboratories of the D.S.I.R. and Universities. This probably arises from the presence of scientific personnel in the firm, men whose training and experience enables them immediately to grasp the significance of technical reports and apply the results in their own organisation.

Large firms should have little difficulty in establishing their own research departments and, with suitable personnel, the results of minor investigations intelligently applied should soon establish the research staff in the confidence of their colleagues. Long-range problems need patience and too much should not be expected, but even if only a fraction of the effort expended bears fruit, the effort will have been worth while.

Smaller Firms' Participation

The position of the smaller firms is undoubtedly difficult, but the fact that these constitute by far the largest number demands a serious awakening to the value of research. According to the London Chamber of Commerce, a census of production carried out by the Board of Trade in 1935 showed that in that year 163,552 firms out of a total of 173,502 included in the census employed fewer than 100 people each, that is, of the firms listed, 94.2 per cent. employed fewer than 100 people each. The Report of the Chief Inspector of Factories and Workshops, issued in 1937, indicated that some 52 per cent. of all workers in factories in 1936 were employed by firms with 250 or less on their pay-roll, whilst only 18 per cent. were employed in factories with 1,000 or more employees. In the light of this, the need for facilities to cover the research requirements, specific and fundamental, of smaller firms must be very evident.

With the advent, in 1917, of the collective research movement, sponsored by the Government through the D.S.I.R. and supported by the larger firms in the industries concerned, it became possible for smaller firms to take advantage of research facilities which individually they were unable to provide for themselves. The tragedy is that only a small proportion of these firms have so availed themselves. For the benefit of those not widely versed in the relationship between the D.S.I.R. and industry, it may be worth while to mention that the research laboratories of the D.S.I.R. consist of the National Physical Laboratory, the Fuel Research Station, the Building Research Station, the Forest Products Research Laboratory, the Road Research Station, a group of stations under the Food Investigation Board, the Water Pollution Research Laboratory, etc. The programme of research for each station is drawn up on the advice of a Research Board comprised of outside scientists and industrialists, with representatives of interested Government departments.

State-aided Laboratories

The National Physical Laboratory is now organised into a group of departments which carry out research, mainly fundamental, directed to industrial needs, but a certain amount of research is done for research associations and for individual industrial firms. The other stations deal with the general needs of the nation in respect of food, housing, fuel, etc., undertake specific work for Government departments and industry and are prepared to act in an advisory capacity. Work conducted for a private firm is paid for by that firm and the results are communicated in the form of a confidential report. The results of the general programme of each station is made available in annual or special reports sold through H.M. Stationery Office and may be acquired by all interested.

The research associations, established in 1917 with the help of a £1,000,000 fund voted by the Government to the D.S.I.R., are self-governing bodies, supported voluntarily by the subscriptions from member firms engaged in the industry for which they cater, or in a few cases by a levy on the raw materials of the industry in question, together with financial grants from the D.S.I.R., the amount of which generally bears some relation to the subscription capital. The D.S.I.R. is responsible for ensuring that there is a "due prosecution of research" on the part of the associations receiving grants from public funds, and the co-operation between the associations and the D.S.I.R. is very close. Most of the associations possess their own laboratories, but some of their work is done in Government or University laboratories or in the laboratories of member firms. The control of these associations is in the hands of councils elected by the members themselves; the results of the work are confidential to members in the first instance, but much of it is subsequently published for the general good of the country.

There are at the present time 24 research associations in receipt of Government grant, whilst others are on the way for shipbuilding, welding and hard coke.

It has been possible to obtain more accurate information from the research associations than was the case with individual firms, and it is of extreme interest to follow their growth. According to the published report of the F.B.I., "the 16 grant-aided research associations in existence in 1927 received a subscription income in that year amounting to £117,000. In 1930, there were 18 grant-aided associations, which received £162,000, in 1935, 20 grant-aided associations received £235,000; in 1938, 22 grant-aided associations received £326,000, whilst in 1941 the subscription income received by 22 grant-aided associations amounted to £368,000. In addition, grants from the D.S.I.R. amounted to £58,000 in 1927, £93,000 in 1930, £113,000 in 1935, £117,000 in 1938, and to £192,000 in 1941." In 1943, the total income of the associations was of the order of £850,000, of which £275,000 was Government grant.

The number of subscribers to grant-aided research associations was, in 1941, over 7,100, and these figures have been slightly increased over the past few years. Corporate groups, such as a trade association, are included in these figures so that the total number of firms covered is appreciably greater than the number of subscribers. Although most of the associations have steadily expanded in size and usefulness, they are not yet on a scale commensurate with the industries they serve. One of the associations now plans to spend £200,000 per annum, but only four of them have an expenditure exceeding £50,000 per annum, and that sum only represents 0.06 per cent. of the turnover of the industries concerned. In comparison with this,

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expenditure by individual American trades amounts to 1.6 per cent. of the gross sales for the radio industry, 1.4 per cent. for the electrical communication industry, and 1.0 per cent. for chemical industry and rubber products. It is stated, however, that in the older industries the ratio of research expenditure to gross sales is much less.

It should be appreciated that it is not only modern types of industry that have co-operated in founding research associations. But of the 24 existing bodies only three or four can be described as serving industries which have developed from recent inventions and research. The majority relate to the old-established industries, and have already shown that traditional methods are equally responsive to scientific investigation and the developments that spring from it.

Apart from the service which the research associations share with the Universities and technical colleges in training men for technical positions in industry they are concerned mainly with research of a fundamental nature which is of interest to the industries they serve as a whole. Like the stations of the D.S.I.R., however, they are generally prepared to undertake specific investigations for individual members, the cost of which is met by the individual firm and the results of which are conveyed in the form of a confidential report. This is a service of extreme value to the smaller firms unable to maintain their own laboratories, and is one of which much greater use might be made. Possibly a feeling exists that the investigation for which a smaller firm meets the cost will become common knowledge, and the onus rests with the associations to inspire the utmost degree of confidence in the truly confidential nature of such specific reports. The research associations are now an established means whereby collective research is carried on and their results are not only beneficial to the industries they serve by reason of the results achieved, but indirectly through the stimulus they have given to firms to undertake their own research, maintain their own routine control laboratories, or at least employ technicians capable of applying the results obtained by the associations, to their own special conditions. There is little doubt that a considerable increase in the number of firms maintaining research laboratories has been experienced since the establish- of the research associations.

Advantages of Co-operative Research

A valuable feature of the movement lies in the collaboration which exists between the research laboratories of interdependent industries, as a result of which unnecessary duplication of work is avoided and data covering a very wide field become available. While speaking of collaboration another aspect might profitably be mentioned. Most research associations possess what have been described as development sections, among the functions of which is the experimental application of research results on a small or medium scale to industrial conditions. All promising research results must first be tried out on a pilot plant to adapt them ultimately to large-scale production, and the stage between the perfection of a new process and its final industrial application may be prolonged and difficult. Heavy expenditure may also be incurred, and the research associations are not always adequately equipped with small-scale plant or in a position to incur heavy expenses in development work. Sympathetic understanding of this aspect of research by the members of the association would be invaluable, and the provision of facilities within the works of member firms where industrial conditions are readily duplicated would be of inestimable value to the associations and the industries alike.

Again, the closest collaboration should exist between the personnel of the research associations and the technical management of the individual members. Only in this way can a true appreciation of the interests of the members be assured and the utmost service be given. This applies particularly in respect of the development personnel upon whom most frequently devolves the task of guiding the member to the proper application of the research results. It is important that the staff of an association should be capable of setting out results in a readily assimilable form. Scientific reports couched in language which the technical personnel of firms cannot assimilate and which does not point directly to methods of application in industrial processes are valueless to the recipients.

Research and the Foundry Industry

Turning, briefly, from this consideration of industrial research on broad lines to a consideration of the position in relation to our own industry, we must appreciate that we as founders have an important part to play. Foundries have passed through a difficult time during the war years in that the demands upon them have been heavy, the standard of quality in respect of castings produced has been exacting, and often ill related to the quality or type of raw materials supplied, and the labour available has not always been of the best. Nevertheless, the foundries have adjusted themselves to the new conditions and ably fulfilled their function. Amazing results have been obtained from modified compositions of non-ferrous alloys, and the so-called high-duty irons have found for themselves applications which are almost unbelievable. Accustomed as many founders have now become to working to close specifications, it should not be difficult for them to maintain and even improve upon their standard of efficiency. Unfortunately, an appreciable number of firms exist where the imposition of specifications has been regarded as a block on production, and it will no doubt occasion alarm to such, to think that control of quality must be maintained in the post-war years. That, however, is the position, and already committees are at work or their establishment has been advocated with the object of revising existing specifications and compiling new ones.

No one familiar with our industry would be bold enough to claim that improvements could not be made in the design and quality of castings, in the processes and materials of manufacture, and not least in the

(*Continued on page* 264.)

FIRST REPORT ON THE BASIC CUPOLA BY THE MELTING FURNACES SUB-COMMITTEE

Discussion on a Paper presented at the annual conference of the Institute of British Foundrymen. Mr. Daniel Sharpe occupied the chair. The Report was printed in our issues of September 14, 21 *and* 28.

MR. S. T. JAZWINSKI (Member) suggested that attention should be directed mainly to dephosphorisation because of the difficulties of dealing with this part of the operation. A point to be borne in mind was that, if one attempted to obtain dephosphorisation or desulphurisation in the cupola, a certain amount of slag was needed, and there must be continuous tapping. The majority of the industry was now using intermittent tapping. Another benefit from using the basic-lined cupola was the ability to obtain high carbon in the cupola metal. The carbon could be up to 4 per cent., and it was recognised that carbon was the important factor in the converter process. He asked Mr. Bolton as to the position of dephosphorising efficiency in the cupola between continuous and intermittent tapping.

MR. L. W. BOLTON (Chairman of the Sub-Committee) replied that it was mentioned in the Report that it had not been found, under the conditions in which the experiments were carried out, that it was possible to obtain the simultaneous removal of phosphorus and sulphur. Heiken claimed that he obtained simultaneous removal of both elements, but up to the present this had not been confirmed. It was found that conditions which were favourable to dephosphorisation were not favourable to desulphurisation. He was inclined to believe that continuous tapping might be an advantage in obtaining dephosphorisation, but that had yet to be proved. This method of tapping was becoming more and more popular, especially in the U.S.A., where it was usual to employ a large receiving ladle which was well insulated and designed so that radiation losses from the molten metal were very small. Admittedly the Americans used, on the average, much larger cupolas than were used in this country and throughputs were larger, and in dealing with these bigger quantities the metal temperature drop was likely to be less noticeable. On cupolas of 5 tons per hr. capacity and upwards, continuous tapping presented no serious difficulty, if a suitable receiving ladle is used, even if the metal was required for batch pouring.

As regards the question of high carbon and its benefit in the converter process, Heiken was very insistent that carbons were extremely high when melting in a basic cupola. Heiken had, however, used intermittent tapping. In the experiments carried out in a continuously tapped basic cupola there had been no confirmation of that, and the carbons obtained had been of the same order that would be expected from melting in an acid-lined furnace.

The Deep Slag Process

MR. J. H. COOPER (Member), after congratulating the Sub-Committee on the Report, said that in the Fryer-Grunder process of continuous tapping a large proportion of the sulphur was removed. At the start, there was a large amount of metal in the cupola, but after the process had been running for a short time there was approximately 23 to 25 in. of slag which absorbed impurities, not only sulphur, but also the oxides. This system was evolved in Germany and plants were installed at the Stanton works and also at the Ford and other works. Personally, he thought that working with a large body of slag had greater advantages than using the basic lining. He asked whether Mr. Bolton thought it was essential in using this process to use a continuously tapped cupola in which the metal was not allowed to stand. He claimed for the Fryer-Grunder process that there was an improved quality of metal.

He did not agree that there was an advantage in having higher carbon, and being connected with the inventors of the Stock converter, he believed that the carbon should be as low as possible, say, 2 per cent. It was true there had been a great deal of controversy on this point, but he had installed Stock converters in 1908 and had been using them ever since. His view was that a converter should be used with reasonable silicon and low carbon. The aim should be not high carbon, but fluidity in the steel, which was most important. With reasonable silicon, the carbon content did not matter as much as was thought by some people.

The New Conception of Converter Reactions

MR. S. T. JAZWINSKI said he did not agree with this view. It was true that the idea based on the Bessemer process was that carbon burned to CO and that the main source of heat was silicon. With 1 kg. of silicon, something like 6,414 calories were obtained, whereas with 1 kg. of carbon which burned to CO, only 2,450 calories were obtained. But it had definitely been proved that carbon in Tropenas converters burned not to CO, but to CO_2, which gave about 8,080 calories, and therefore the main source of heat was carbon. There was an example of this at Stanton, where the silicon content was only 0.2 per cent.

MR. COOPER said he agreed about the oxidation of carbon to CO_2, but silicon was burned in the bath, and his contention was that, as silicon was burned in the bath, the whole of the benefit of the silicon was obtained. The carbon was burned out of the bath and in that way the benefit of the carbon was not obtained.

The CHAIRMAN (Mr. D. Sharpe) remarked that, whilst this divergence from the subject of the Report was of

Basic Cupola Report

interest, he must ask speakers to keep to the discussion of the basic cupola.

Application to the Manufacture of Basic Steel

MR. F. L. ROBERTSON said this Report was of enormous importance and interest to basic-steel makers. He was not going to labour its obvious application to steelmaking, but confine his remarks to the process itself. The key to the process was an understanding of the passage of carbon, sulphur and phosphorus between the metal on the one hand and the slag and gas or fuel on the other hand.

To deal first with sulphur—the element in this process that bothered basic-steel makers most—the Report showed a slag to metal sulphur ratio of 20 at a temperature of 1,450 deg. C. This seemed an extraordinary high ratio for the particular slag analysis given. He believed he was right in saying that the electric furnace working with a much more basic slag and a temperature of, say, 1,630 to 1,650 deg. C., only achieved a slag to metal sulphur ratio of 30. In the production of the mildest steels (0.05 per cent. C) basic open-hearth steel makers were very proud if they achieved a ratio of 6. That figure was only possible if the P_2O_5 and SiO_2 content of the slag was the lowest that was consistent with slag fluidity during the working of the charge. The low $P_2O_5 + SiO_2$ allowed for a high free-lime content. He thought the slag analysis the Sub-Committee gave of 30 per cent. silica and 45 per cent. lime would prove too acid to give consistent low-sulphur metal. If this high silicon were necessary, and it well might be to give the necessary liquidity to the slag at 1,450 deg. C., would the additions of any other alkaline earth or alkali give a higher ratio. He had in mind strontia and soda. If these did make a difference to the ratio it might still be an impractical suggestion as the refractory makers might not be able to produce the necessary refractory.

The Phosphorus Reaction

Basic-steel makers would probably be quite willing to pay no attention to the question of phosphorus. The amount of phosphorus that would turn up when steel scrap was the raw material could be taken in their stride without tremble. The Sub-Committee had, however, opened the eyes of steelmakers. They were dephosphorising under conditions that the basic-steel maker would say were impossible. K values for the phosphorus equation had been worked out, and the speaker had tested them out on many furnaces in different works, and was quite willing to accept them. These K values simply do not fit the Sub-Committee's result. It seems that the Sub-Committee, in some earlier works to which they refer, have tumbled on a new chemical method of dephosphorising that works under strongly reducing conditions. It may well be possible that the phosphorus is being distilled off a hot working cupola. That this does not happen in a blast furnace may be no argument to the contrary. It may occur at the metal level, and the phosphorus may be condensed or oxidised by the increasing CO_2 higher up. Their dephosphorising results at high carbon metal content had interested the speaker as a basic-steel maker so much that he would ask the Sub-Committee to prosecute their enquiries further and do their best to elucidate the chemical principles of their very interesting results.

Carbon elimination as distinct from sulphur and phosphorus elmination was a time temperature process, and the open-hearth steel maker groaned when he saw the appallingly high carbons this process tapped out. Had the Sub-Committee considered a gas or, better, an oil-fired cupola working, if necessary, on oxygen-enriched air? If such a cupola were worked so that the issuing CO/CO_2 mixture had a composition of about 35 per cent. CO_2, then (1) there ought to be no FeO formed anywhere in the cupola, (2) the rate of carbonisation of the charge would probably be very much slower than when the metal both before and after melting was in contact with naked coke.

Fuels Other than Coke Suggested

In the coke-fired cupola there must be a time lag between the entry of the air into the cupola and when it comes into contact with the coke. During this interval FeO must appear and hence the wear of the cupola lining. In the absence of FeO a silica-lined cupola would withstand 1,680 deg. C. and a magnesite lined over 2,000 deg. C., and a fireclay-lined cupola some fairly definite lower temperature. All of them, if worked within the limits of the refractoriness, should last without repair for a long time, as long as FeO was absent. The only enemy would be mechanical abrasion as the charge descended. An oil or gas-fired burner could be made to give an issuing flame that would be reducing in reference to the Fe-wustite-Fe_3O_4 diagram. This is about 35 per cent. CO_2 of the CO/CO_2 content.

MR. BOLTON, replying with regard to the ratio of sulphur in the slag to sulphur in the metal at the temperatures operating, said that no attempt was made to obtain the maximum temperatures from this cupola, and it would be possible to increase the temperature quite appreciably, say as much as 50 deg. C. The only difficulty in doing that in normal operation was that it would involve the use of more fuel, and the use of more fuel meant more sulphur coming into the furnace, and possibly no great advantage would be derived. The only way he could think of increasing the temperatures without increasing the fuel would be by the use of pre-heated blast, and it was possible that something might be done in that direction. He should have mentioned, when he introduced the Report, that there was an error in the slag analysis in Table X of the advance copy. The lime figure should be 38.41 per cent. and not 30.41 per cent., but the Sub-Committee was not at all certain that that represented the limit to which it was possible to go in lime contents. It was intended to carry out some more work to ascertain whether it was possible, as had been suggested, to use some other alkaline material to increase the basicity of slags. He thanked Mr. Robertson for his suggestions, and promised to bring them to the notice of the Sub-Committee.

Claims Refuted

MR. P. MURRAY, speaking with regard to the Fryer-Grunder continuous tapping arrangement, said that it might also be pointed out that this arrangement was used on acid practice prior to the inception of the basic cupola. Although the device served its purpose very well, no cases had been reported of any desulphurisation being obtained by its use, and soda ash treatment had been necessary in order to reduce the sulphur content of the metal to specification limits. As had been pointed out, two basic linings had been installed on large cupolas (84 in. and 90 in. internal diameter respectively) where the slag was separated by normal methods and in each case desulphurisation and/or dephosphorisation had been obtained.

It must be emphasised that the degree of desulphurisation and dephosphorisation depended on the basicity and viscosity of the slags. So far, the removal of the phosphorus and sulphur had been obtained by a cautious increase in the limestone of the charge, as it was realised that "bridging" would result if the CaO content of the slag was increased too much. It was therefore necessary to provide a suitably basic slag which would be fluid at cupola operating temperatures. Temperatures taken at the slag notch showed that the slag was at 1,400 to 1,450 deg. C. when flushed off. Hence, the first conditions of the slag was sufficient fluidity at 1,400 deg. C.

Theory of Phosphorus Removal

The second consideration was basicity, *viz.*, how basic must the slag be to obtain maximum sulphur or phosphorus removal, and how was it that dephosphorisation took place with a much less basic slag than was used in the other steelmaking process. Recent work in America had thrown light on the mechanism by which dephosphorisation proceeded in the basic open-hearth process. Microscopic examination of a large number of slags revealed that the phase of primary crystallisation was light coloured and doubly refracting. Further analysis showed that it consisted essentially of SiO_2, CaO and P_2O_5. This light coloured phase had similar optical properties to beta dicalcium silicate except that the indices and birefringence were abnormally low. It was suggested that the phosphorus in the slag might be carried in solid solution in the silicate phase, thus altering the optical properties of the latter. This was confirmed and an investigation made of the extent of solid solution of dicalcium silicate and tricalcium phosphate. The great degree to which solid solutions could exist between these compounds was demonstrated, and the important conclusion was that dephosphorisation could only occur when the CaO content of the slag approached and exceeded the orthosilicate ratio. The slag, therefore, must have a CaO/SiO_2 ratio greater than 1.87.

CaO/SiO_2 Ratios

The slags used in the dephosphorisation melts in the basic cupola had a CaO/SiO_2 ratio much less than 1.87, but although the CaO content was insufficient to combine with all the silica as dicalcium silicate, a certain amount of dicalcium silicate was formed. Thus the amounts calculated from the CaO-SiO_2-Al_2O_3-MgO diagram, were as follow:—

Melt.	Analysis of Slag, recalculated to 100 per cent. basis.				Dicalcium silicate, per cent.
	CaO	SiO_2	Al_2O_3	MgO	
D.P.1 ..	46.5	30·4	11.0	12.0	37.0
D.P.2 ..	46.1	27.9	11·8	14.1	41.0
D.P.13 ..	44.7	34.3	9.4	11.5	23.3
D.P.17 ..	45.7	36.0	8.3	9.8	22.9

It was known that dicalcium silicate itself could contain up to 10 per cent. P_2O_5 in solid solution, and it was thought that the removal of phosphorus had occurred in this manner. Nevertheless, a more satisfactory dephosphorisation would be obtained by working with a higher CaO/SiO_2 ratio.

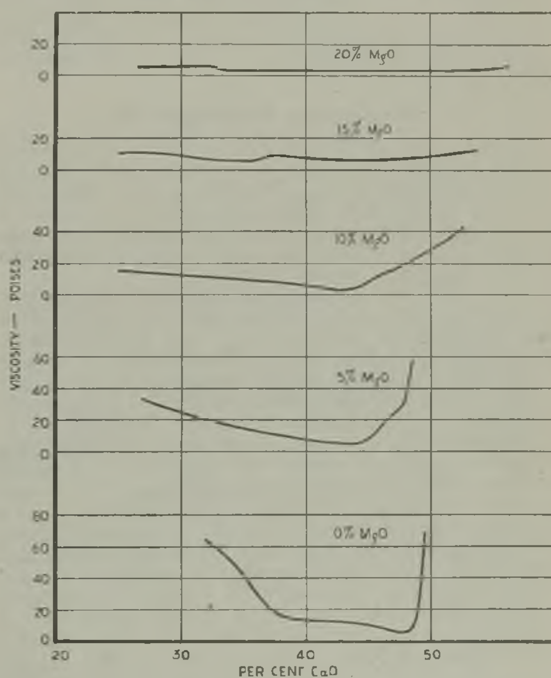

FIG. A.—EFFECT OF MAGNESIA ON THE VISCOSITY OF CaO-Al_2O_3-SiO_2 SLAGS AT 1,400 DEG. C. ($Al_2O_3 : SiO_2 : 1 : 4$).

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Reverting to the question of viscosity, he said that the work carried out by McCaffery and his co-workers on blast-furnace slags was of great importance. McCaffery investigated the range of percentage compositions SiO_2, 25 to 55; Al_2O_3, 0 to 35; CaO, 25 to 55; and MgO, 0 to 20; and had determined the viscosities at temperatures varying from 1,250 to 1,650 deg. C. From the accompanying diagram (Fig. A), giving the viscosity-composition relationships at 1,400 deg. C., it would be seen that:—(1) Magnesia is very effective in reducing the viscosity of CaO-SiO_2-Al_2O_3 slags; and (2) when slags have a magnesia content of say, from 15 to 20 per cent., there is no great difference in viscosity with considerable changes in the CaO-SiO_2-Al_2O_3 components.

The extension of these principles to basic cupola slags was obvious. Thus it would be seen that, with no magnesia in the slag, it was difficult to obtain a fluid slag in the region of 45 to 50 per cent. CaO, since the viscosity increased very sharply. With 20 per cent. MgO in the slag, the viscosity was approximately the same (5 poises for any CaO-SiO_2-Al_2O_3 composition) and a slag containing 45 to 50 per cent. CaO would be sufficiently fluid at 1,400 deg. C. The question of the exact meaning of viscosity in terms of poises could be settled by comparison with a known liquid; thus glycerine had a viscosity of 8.5 poises at 20 deg. C.

Developing a Highly Basic Slag

So far, the fact that the basic cupola slags had run had been fortuitous in that the MgO in the slag had come from the lining. Working on the above lines, it was proposed to develop a highly basic slag and obtain the fluidity by substitution of raw dolomite for some portion of the limestone charge. Experiments were proceeding in this direction.

Mr. Bolton remarked that, although Mr. Murray's name did not appear on the list of members of the Sub-Committee, they had from time to time had the benefit of his advice in the preparation of the Report. He agreed with Mr. Murray that the slags so far produced were not highly basic, which was a factor that had worried Mr. Murray all along. It was to be expected that, in any cupola, oxidising conditions would exist immediately above the tuyeres, but, as shown in the Report, if a material like iron oxide was charged, in an endeavour to obtain more oxidation in the cupola, the oxide was reduced. It appeared that it would be difficult to produce oxidising conditions in a cupola to the extent normally regarded as necessary for the removal of phosphorus. There was undoubtedly a great deal of work to be done before the reactions taking place in the removal of phosphorus in the cupola were understood, and it was possible that these reactions were in no way similar to those involved in the steelmaking processes.

Mr. W. H. Salmon (Member) was particularly interested in the extent to which the phosphorus content had been reduced by the previous speaker (Mr. Murray). Whilst it would be of advantage to obtain some sulphur removal during the melting operation in the cupola, it was of more importance that attention should be concentrated on phosphorus removal. The sulphur could be reduced by the usual ladle treatment of the molten cast iron with soda ash, but the great advantage of the basic cupola was the possibility of removing phosphorus. It was not likely that conditions which gave the optimum phosphorus removal in the cupola would give the optimum sulphur removal, and that was why he suggested that the investigators should devote their attention to phosphorus in those cupolas working in conjunction with side-blown or bottom-blown converter plants. He would like to congratulate Mr. L. W. Bolton and his fellow investigators on the Melting Furnaces Sub-Committee on the rapidity with which they had published the results of their experiments for the guidance of other metallurgists who contemplated work with basic cupolas.

The Chairman said the Sub-Committee would welcome any suggestions and ideas that might be sent to them for trying out. He himself would make a suggestion, which might seem rather stupid. The addition of alkalis other than lime had been mentioned, and he would like to see incorporated either lime or another alkali blown in. According to Mr. Murray's figures, it would appear that dephosphorisation should take place at the surface of the slag. If it were possible to get high lime and high basic conditions above the slag, it might be possible to accomplish something which would give a top surface of the slag of higher basic value.

Mr. Bolton said the discussion on the Report had pleased him very much. He was sure the Sub-Committee would welcome the suggestions that had been made and they would be of considerable assistance in connection with future work.

Maintaining the Silicon Content

Mr. C. J. Dadswell, B.Sc., Ph.D. (Member), referring to the silicon content, asked whether the low value which was an advantage to the process would be a disadvantage if the iron was used in a surface-blown converter. If this were the case, would it be advisable to maintain the low silicon content and compensate for it by the use of a triplex process such as was used at Stanton, where he understood that low silicon cupola iron was put in a rotary furnace for a sufficient length of time to raise its temperature, to help the initial blow?

Mr. Bolton replied that if the problem with regard to phosphorus in the steel industry was phosphorus present in conjunction with a certain amount of silicon, *i.e.*, in cast-iron scrap or pig-iron, it might prove more difficult to remove than if present in steel or wrought-iron scrap. The results so far available were fairly definite that silicon, if present in the metal which contained the phosphorus, did inhibit dephosphorisation, and possibly the best results would be obtained if the silicon could be kept to the absolute minimum in the charge. In that case the triplex process referred to by Dr. Dadswell might be the answer to the problem, although he could see no real reason why silicon sufficient for the normal Tropenas converter process should not be added to the molten metal after it was tapped from the cupola.

Influence of Blast Conditions

MR. H. T. ANGUS, Ph.D. (Member), speaking with regard to the control of the blast, said the process depended for dephosphorising on maintaining oxidising conditions and for desulphurising on maintaining reducing conditions. If he understood the Report correctly, it was difficult accurately to determine whether there were oxidising or reducing conditions. At the base of the tuyeres there were bound to be oxidising conditions, in the centre of the cupola there would be oxidising or reducing conditions, depending on blast pressure, diameter, etc., and lower down there would be reducing conditions. Had the Sub-Committee considered the question of redistributing the blast in the cupola in order to control the conditions and obtain oxidising or reducing atmospheres in the various zones when required?

MR. BOLTON replied that the blast had been very carefully measured in these experiments. The weight of air supplied was shown in the paper to be 250 lbs. per min. He agreed that more work was required in regard to producing a more oxidising atmosphere in the cupola, but trouble had been experienced with the refractories when the conditions became unduly oxidising. It was known that if a cupola with basic lining were pushed beyond its normal capacity—which was necessary if oxidising conditions were to be created—the life of the refractory was reduced. As a consequence, they had up to the present been a little afraid of going out for seriously oxidising conditions, and it could be said that none of the experiments on dephosphorisation was carried out with particularly oxidising conditions in the cupola. That was work which it was intended to carry out in the near future.

A cordial vote of thanks was given to the Sub-Committee at the conclusion of the discussion.

WRITTEN CONTRIBUTION

Repair Problems

MR. N. L. EVANS, B.Sc., A.I.C. (Member), wrote:—The Melting Furnaces Sub-Committee was to be congratulated on its Report on the basic cupola, which seems likely to have far-reaching effects in connection with steelmaking. The importance of a low sulphur content in iron for making castings by the side-blown converter method had long been recognised, and any methods of reducing sulphur still further would facilitate the employment of greater proportions of steel scrap, a tendency which had been particularly noticeable since the outbreak of the war.

Personal experience with stabilised dolomite had been confined to its use for ladle linings, where it had proved valuable as a means of increasing the efficiency of the sodium carbonate desulphurising process. In the course of the past four years during which the investigation of this subject had been in progress, there had been a considerable improvement in the physical strength of monolithic linings made from stabilised dolomite, due to better knowledge of grading.

The Report referred to difficulties in preparing a satisfactory patching material for basic cupolas. The same difficulty was experienced with basic-lined ladles. The material behind the working face becomes very friable after use, but the working face itself was strengthened by the cementing action of the slag. It was noticeable that in a newly lined ladle the first charge of sodium carbonate was practically completely absorbed as soon as it melted. This suggested that, where the highest degree of refractoriness was not essential, the addition of a small percentage of light sodium carbonate to the stabilised dolomite might improve the bond.

Patching material would not adhere satisfactorily to a glazed surface, and, in the writer's opinion, it was essential to remove glaze from the refractory surface before applying the patching material, to ensure that the latter adheres.

Reference was made in the Report to the use of liquid sodium silicate mixed with stabilised dolomite for making a monolith. Two points should be stressed in this connection:—(1) It was not generally appreciated that sodium silicate was manufactured in a number of different grades differing as regards the ratio SiO_2: Na_2O. The correct grade to use with stabilised dolomite had an approximate weight ratio $SiO_2 : Na_2O = 2 : 1$. (2) Special apparatus was necessary for dissolving sodium silicate in water, and it should be purchased as a solution to avoid any difficulty in dissolving. The exception to this rule was in the case of anhydrous sodium silicate glass, which might be mixed with refractory materials when the intention was to rely solely on the effect of high temperature to give a bond by a fluxing action.

As to the spalling of stabilised dolomite bricks, experience with ladle linings had shown that this caused far less trouble than would be anticipated from the results of the standard spalling tests applied to bricks. The probable explanation of this was that, once the bricks had been used and had had their surface impregnated with slag, the composition and physical properties were radically altered and bore little relation to the original material.

The Sub-Committee's Reply

The Sub-Committee value the appreciative way in which the Report was received, and find this an incentive to proceed with the work. The verbal replies made by Mr. L. W. Bolton at the meeting are endorsed, but the opportunity is taken of amplifying the replies to certain speakers as follows:—

With regard to Mr. Cooper's remarks concerning desulphurisation in an acid-lined cupola by the use of a continuous tapping and slagging spout, the experience of the Sub-Committee supports the statement made by Mr. Murray that no appreciable removal of sulphur is obtainable by such means.

Basic Cupola Report

Mr. Robertson's remarks imply that he is mainly interested in the application of the basic cupola to the open-hearth plant, and in this application sulphur and carbon are the two important elements to be considered. It has been shown that metal low in sulphur can be produced from the basic cupola, depending on the charged materials. It may be necessary in open-hearth plants, however, to work with all steel, low-silicon charges. While this would be of assistance in yielding the desired low-carbon contents, special consideration would be necessary, as charges of this type are very easily oxidised. If the conventional cupola produces metal of too high a carbon content for the open-hearth plant, then, as suggested by Mr. Robertson, some special type of shaft furnace utilising fuel other than coke would become necessary. Such furnaces have been designed and used for special applications, but it is felt that such considerations are outside the scope of the present Sub-Committee.

The Sub-Committee finds the remarks made by Mr. Robertson on the theory of sulphur and phosphorus removal of great interest. It is agreed that existing knowledge of bath-type furnace reactions must be applied wherever possible, but at the same time an open mind is necessary when considering the entirely different set of conditions which exist in the cupola. The high slag to metal sulphur ratio with a high silica-content slag may appear contradictory, but it is known that in the basic cupola desulphurisation is possible with this type of slag. That this is so is undoubtedly due to a condition peculiar to the cupola furnace. Although the reported slag analyses show high silica contents, such percentages are not essential. Silica will inevitably be present in the cupola, but if slags of higher basicity are necessary, it could be reduced by dilution with a base. In the bulk of the work so far reported, the silica has been the controlling factor in producing a workable slag at operating temperatures.

In discussing dephosphorisation, Mr. Robertson agrees with the Sub-Committee that the steelmaker would consider phosphorus reduction to be impossible with slag conditions such as existed in the experiments. However, dephosphorisation has been obtained, and it is necessary to develop an independent theory applicable to the cupola. Mr. Roberson's suggestion that the process works under strongly reducing conditions may not be correct. With a normal quantity of coke and a balanced air input, there is, as stated by Dr. Angus, a definite zone in the cupola in which oxidation occurs. Silicon-free metal would be extremely susceptible to oxidation in this zone and, as the requirements show, with diminishing silicon the dephosphorisation is intensified, which appears to point to oxidation. The suggestion that the phosphorus may be distilled off in a hot-working cupola is of interest. Yaneske (Journal, Iron and Steel Institute, 1937, No. 1) reports a phosphorus reduction in the acid-Bessemer converter from 0.292 to 0.250 per cent., despite a 10

(*Continued at foot of next column.*)

A MOULD & CORE DRYING THEORY

A leaflet received from Modern Furnaces & Stoves, Limited, of Booth Street, Handsworth, Birmingham, poses the question as to how their particular drying system gets rid of the steam and whether it can provide dry air in the stove for absorbing the moisture.

Dealing with the second question first, the leaflet states that the general belief that dry air should be instrumental in drying cores and moulds, as it is in textiles, foodstuffs, etc., is a wrong conception of drying processes. Because all the cores and moulds are dried at temperatures above the boiling point of water, and in this case drying is not a process of absorbing moisture but air, simply and exclusively by a process of boiling off water. At 100 deg. C. the vapour pressure of water reaches atmospheric pressure, and steam is produced irrespective of any presence or condition of air. One could dry a load of cores just as well by blowing a sufficient quantity of super-heated steam through the stove instead of products of combustion.

It is therefore useless and unreasonable to blow cold air over the fire into the stove because this requires extra fuel, and only increases the losses through the chimney without doing any good to the drying process. Secondary air, unless heated up at least 200 deg. C., will not give any secondary combustion either, and a costly recuperator would never pay in connection with a drying stove.

As to the first question, the steam gradually escapes through the chimney because new products of combustion continuously enter the stove and displace an equal volume of waste gases plus steam.

During the drying process super-heated steam is recirculated together with other hot gases, and well serves for drying; but all the steam has disappeared through the stack long before the stove cools down.

(*Continued from previous column.*)

per cent. loss of metal due to oxidation of the elements, and has suggested that this removal of phosphorus is caused by volatilisation. Another suggestion put forward is that the loss may follow the equation: $5FeO + 2Fe_3P = 11Fe + P_2O_5$. These points will need to be considered when more work has been carried out and before a final theory is attempted.

The Sub-Committee wishes to record its thanks to Mr. Murray for his contribution to the discussion. The references to the work of McCaffery are of great interest, as this work clearly indicates the increase in slag fluidity with increasing quantities of MgO up to 20 per cent. Experiments carried out on these lines have shown that the substitution of raw dolomite for limestone has resulted in improved operation of the basic cupola under certain conditions, and it is hoped to pursue this matter further.

The Sub-Committee has read with interest the contribution made by Mr. N. L. Evans, for which thanks are tendered. The difficulty mentioned in applying basic patching material to ladle linings has so far not been encountered in the patching of cupola walls.

GATING A VALVE COVER

By "W. G."

A sound and clean casting is essential when supplying the valve cover shown in Figs. 1 and 2, as these components have to withstand a fairly high pressure test, and nothing short of these conditions will pass inspection. As indicated in Figs. 1 and 2, there are two ways of making the mould, one with the flange down and the other method with the flange uppermost. The former method of moulding the valve resulted in some rejections due to sponginess in the boss, as revealed in the machine surface after boring through to the body core. The design of this cover casting shows different thicknesses of metal, the boss, for instance, which is cast solid, measuring 2 in. by 8 in., whilst the walls and flange are $\frac{5}{8}$ in. and $1\frac{1}{2}$ in. respectively. These variations of thickness, no doubt, account for one of the causes of the troubles. Although the boss was fed with a $\frac{3}{8}$-in. rod, sponginess more or less persisted, sometimes to a pronounced degree.

FIG. 1.—THE FLANGE AT THE BOTTOM METHOD.

FIG. 2.—THE FLANGE UPPERMOST METHOD.

Better results were obtained by making the mould with the boss downward, as indicated in Fig. 2, as it enabled the boss to receive a certain amount of pressure from the rest of the casting. The gating of the mould was altered to allow the molten metal to enter the boss by a horn gate, $\frac{3}{4}$ in. dia., which was made from a length of electrical conduit tube bent to the required sweep.

The design of this horn gate has much to recommend it, as it is economical to supply and easy to fix, and, given a little taper by means of the grindstone, is easily withdrawn. The body core sits in a print in the top part and is firmly secured by two hook bolts. As the face of the flange has to be machined and bolt holes have to be drilled, the iron is preferably poured at a high temperature. The weight of the casting is of the order of 200 lbs.

IRONFOUNDRY FUEL NEWS—XXX

In the majority of cases, once molten iron is poured into its mould, the heat which it contained is, for all practical purposes, lost. One or two ironfounders are known, however, not to have accepted this situation without thought and have, in fact, succeeded in putting to good use some of the heat contained in the solid, but still hot, castings. One foundry in the East Midlands dries large ladles initially with any waste timber which is available, and then completes the process by putting hot stripped castings into the ladles. Another, in the Sheffield district, is sometimes able to use the hot castings for drying floor moulds.

A more common application, for castings of suitable size, is direct space heating—those castings which remain hot long enough are stripped first thing in the morning and the heat radiated from them is sufficient to keep the shop warm until pouring begins again. Foundrymen should make sure that full use is made, wherever possible, of every available scrap of heat.

A PLEA FOR THE EXTENSION OF RESEARCH

(*Continued from page* 256.)

conditions, economic and physical, under which they are made. These improvements can only be made as the results of an intensive and searching enquiry, coupled with a vastly expanded programme of industrial research. Many firms which have not yet seen fit or found it practicable to establish their own research departments would be well advised to give the matter serious thought, whilst smaller, and many larger firms, which are not yet members of their appropriate research association, would do well to establish that connection.

The Government has already given a lead to its policy for the future, and industry might take its cue therefrom. On April 19 last, Mr. Attlee, the Deputy Prime Minister, said that the Government would adopt a bold policy and offer financial assistance to extend research by industry through private firms and research associations. Sir John Anderson, Chancellor of the Exchequer, on April 25 last, introducing the Budget, said that research stood on a different footing from the other expenditure of a trader, and that there was a case for modifying in its favour the distinction which the Income Tax Acts draw between capital and revenue expenditure. It is proposed that any research expenditure of a capital character, for instance, laboratories, plant, machinery, etc., should be allowed over a period of five years or over the life of the assets if shorter, as a deduction from profits for income-tax purposes. In addition, all current research expenditure such as salaries, wages, cost of materials, repairs and so forth would be allowed as and when incurred by the trader. Any payment, whether for capital purposes or not, made to an approved central research body, is to be allowed as a deduction in compiling profits. Contributions to research carried out by a University or college on matters of concern to the traders' business will similarly be allowed. This is a valuable concession and should prove a stimulus to our industry in the application of research to its problems.

Work of the B.C.I.R.A.

Information regarding the number of foundries which operate their own laboratories or have access to general works' laboratories is not available, but, broadly speaking, the proportion must be relatively small, and should be vastly extended. Nor is information at hand on the number of steel and non-ferrous foundries which are members of their respective research associations, and comment on this side of the industry must accordingly be withheld. It will, no doubt, be interesting to many of our members, however, to learn something of the extent to which the cast-iron branch has reacted to the formation of the British Cast Iron Research Association. My own connection with the B.C.I.R.A. makes me diffident about enlarging upon the activities of that body from this platform, nevertheless, I feel that an address on the subject of industrial research would be incomplete were I purposely to ignore the research association which caters for the interests of so many of our members.

Founded in 1921, the B.C.I.R.A. at the end of its first financial year had a total income, including Government grant, of approximately £5,100, and an ordinary membership of 115. By the end of its fifth year of existence ordinary and trade membership had increased to 230, and the total income approximated to £8,400. At this period also, the laboratories in Scotland were acquired by amalgamation with the Falkirk Technical Institute, the organisation and maintenance of which became directly under the Association. In 1939 membership, ordinary and trade, amounted to 354, with an income of £18,000, and in 1943 this had expanded to the gratifying total of approximately £29,000, with an ordinary and trade membership of 449. Among ordinary members is included as one unit several associated firms, so that individual firm membership is appreciably higher than the figure quoted. The vast increase in income was largely contributed to as the result of an appeal to the industry for increased funds to meet the cost of establishing new premises, and it is worthy of mention that this appeal accomplished that end, the Association having been enabled to acquire new, enlarged, and permanent premises which were formally opened in May, 1943. Membership has still further increased, and it is confidently anticipated that the income for the financial year ending 1944 will be on the same high level as in the former year.

This expansion must surely be interpreted as a sound indication of the value placed upon the work of the Association by its members, and should be an inducement to other firms to benefit from membership. At present there are in existence 1,745 grey and malleable cast-iron foundries in the country, about one half the total output of which is produced by members of the Association. All the largest firms are members, and medium-sized foundries are well represented. Smaller firms have much to gain, if not more than the larger, by taking advantage of the facilities offered to them by collective research, and the present is undoubtedly a fitting time in which to review their position.

In conclusion, I should like to draw attention to the Report of the Federation of British Industries' Industrial Research Committee, the Report of a Special Committee of the London Chamber of Commerce, and a publication by Sir Harold Hartley, F.R.S., on "Industrial Research," all of which are worthy of study and from which valuable information has been drawn in compiling the present address.

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"BEACON"—Rolled and cast building materials and fittings. SMITH & DAVIS, LIMITED, Hospital Street, Birmingham, 19.

"DRABALOY"—Unwrought and partly wrought common metal alloys; machine tools and parts made of metal alloys; hand tools wholly or principally of metal alloys. SPEAR & JACKSON, LIMITED, Aetna Works, Savile Street East, Sheffield.

NEWS IN BRIEF

JOHN ANDERSON & COMPANY (ENGINEERS), LIMITED, is being wound up voluntarily. Mr. E. T. Wilson, 47, West Street, Gateshead, is the liquidator.

THE EMPIRE DIRECTOR of the Federation of British industries, Mr. Moir Mackenzie, C.M.G., O.B.E., is now in Canada, and Mr. C. F. I. Ramsden, the Foreign Director, is in France to see how the Federation can re-establish its representation in that country.

KEIGHLEY ASSOCIATION OF ENGINEERS are holding a ladies' dinner and social evening in the Assembly Room of the Mechanics' Institute, Lord Street, Keighley, on December 2. There will be a reception at 5.30 p.m. by the President, Mr. W. Womersley, and Mrs. Womersley.

SPEAKING IN LONDON recently, Mr. Ernest Bevin, Minister of Labour and National Service, said that when he took office he urged his colleagues to put their trust in industrial councils. Events had proved that his confidence was not misplaced. War production could not have been carried on as it had been without their machinery.

THE DIRECTORS OF G. & J. Weir, Limited, Holm Foundry, Cathcart, Glasgow, have agreed to pay the fees of any members of their staff, becoming students, graduates, or associates of technical institutions. There are seven institutions covered by the scheme, including mechanical and marine engineering, chemistry, and secretarial and accountancy services.

MR. GEORGE A. ISAACS, M.P., deputy chairman, presided at the annual meeting of the Industrial Welfare Society, held in London on November 17. It was reported that membership continued to increase, a pleasing feature being the large number of firms of less than 500 employees which had joined during the year. Total membership was now 2,300.

A SHORT CONFERENCE on "The Selection and Training of Personnel for Industry" will be held under the auspices of the London and Home Counties Branch of the Institute of Physics at 2 p.m. on December 2, in the Lecture Theatre of the Royal Institution, Albemarle Street, London, W.1. The conference will open with an address by Major F. A. Freeth, F.R.S., of Imperial Chemical Industries, Limited. Visitors will be welcome.

A JOINT MEETING of Sheffield Metallurgical Association, Sheffield Society of Engineers and Metallurgists, and the Iron and Steel Institute will be held at the Royal Victoria Hotel, Sheffield, on December 2, at 2.30 p.m. Mr. R. Staton, President of Sheffield Metallurgical Association, will be in the chair, and will be supported by Mr. F. Wardrobe, President of the Sheffield Society of Engineers and Metallurgists. The following two Papers will be presented by their authors:—"Tensile Properties of Unstable Austenite and its Low-temperature Decomposition Products," by Dr. A. H. Cottrell, and "The Effect of Overheating on the Transformation Characteristics of a Nickel-Chromium-Molybdenum Steel," by Dr. K. Winterton.

PERSONAL

MR. EDWARD SLATER, managing director of Slater & Crabtree, Limited, press tool makers, has been elected Mayor of Wakefield.

MR. J. H. WALLER has been appointed commercial manager of Arden Hill & Company, Limited, gas apparatus makers, of Birmingham.

MR. M. J. B. WHITBY and MR. T. M. PRIESTLEY have been appointed additional directors of the Anti-Attrition Metal Company, Limited.

MR. GEORGE A. STONLEY, works manager of M. W. Swinburne & Sons, Limited, engineers and brassfounders, Wallsend, has completed 50 years with the firm.

MR. WILFRID AYRE, chairman and managing director of the Burntisland Shipbuilding Company, Limited, has been elected chairman of Hall, Russell & Company, Limited, Aberdeen.

MR. T. A. HETHERINGTON recently completed 50 years' service with the North Eastern Marine Engineering Company (1938), Limited, at the firm's Sunderland works. He has been presented with a gold watch by Sir Summers Hunter on behalf of the directors. Mr. Hetherington entered the firm's service as a boy and is now cashier.

SIR WILLIAM TALBOT, of Walsall, and BREVET COLONEL HAROLD BANTOCK SANKEY, of Albrighton, have been nominated for the office of High Sheriff of Staffordshire. Sir William Talbot is principal of the Talbot Stead Tube Company, Limited, of Walsall, while Col. Sankey is managing director of Joseph Sankey & Sons, Limited, Bilston.

MR. E. A. MEARNS, who has been in charge of the company's activities on the marine side since 1933, has resigned his position as joint managing director of the Manganese Bronze & Brass Company, Limited. MR. A. T. THORNE, who was for some years general manager of the Neptune Engine Works of Swan, Hunter & Wigham Richardson, Limited, has been appointed joint managing director in succession to Mr. Mearns.

GOVERNMENT PURCHASES OF TUNGSTEN ORE

The Minister of Supply announces that the purchase of tungsten ores on Government account will continue for the first six months of 1945, but as from January 1 the normal price will be reduced to 75s. per long ton unit of WO_3, f.o.b., for Empire producers and f.o.r. for producers in the United Kingdom. Only concentrates of the normal saleable grade will be accepted and the quality specification will be revised to impose heavier penalties for low WO_3 content and arsenic and penalties for copper, molybdenum and scheelite in wolfram.

Any inquiries should be addressed to the Director for Ferro-Alloys, Iron and Steel Control, Steel House, Tothill Street, London, S.W.1.

COMPANY RESULTS

W. G. Allen & Sons—Interim dividend of 2½% (same).

Whitehead Iron & Steel Company—Interim dividend of 10% (same).

Lake & Elliot—Final dividend of 15% (same), making 20% (same).

South Durham Steel & Iron Company—Interim dividend of 6% (same).

Marshall Sons & Company—Final dividend of 10% (same), making 13¾% (same).

South African Manganese—Profit for the year to June 30, £22,480 (£20,948). No dividend (nil).

Imperial Smelting Corporation—Ordinary dividend for the year ended June 30, 1944, of 4%, less tax at 9s. 11d. (same).

Aron Electricity Meter—Net profit to March 31 last, £19,064 (£20,222); dividend of 15% (same); forward, £17,379 (£14,710).

Matthew Hall & Company—Profit for 1943, after charging bank interest and providing for depreciation of fixed assets and taxation, £4,618, reducing the debit balance brought forward to £7,803.

John Bedford & Sons—Profit to September 30 last, after £9,318 (£10,185) depreciation and £41,222 (£58,400) taxation, £9,011 (£7,065); ordinary dividend of 10% (same); forward, £5,431 (£5,420).

J. Brockhouse & Company—Net profit for the year ended September 30, 1944, after providing for taxation, £125,128 (£124,791); final dividend of 12½%, making 20% (same); forward, £173,946 (£139,298).

Electrolytic Zinc Company of Australasia—Net profit for the year to June 30 last, £292,574 (£292,765); dividends totalling 9% (same) on both the preference and ordinary shares; forward, £235,477 (£219,653).

British Rola—Net profit for the year to March 31, 1944, £45,304 (£39,237); taxation, £34,300 (£31,308); deferred repairs, £2,000 (nil); preference redemption, £1,275 (£1,206); preference dividends, £2,366 (£2,398); ordinary dividend of 15%, £5,625 (same); forward, £2,132 (£2,394).

Wilkes—Net profit for the year to July 31, £10,696 (£7,756); taxation, £5,508 (£4,163); reserve for taxation not now required, £3,500 (nil); to general reserve, £6,000 (£2,000); dividend on the preference shares of 7%, less tax, £546 (same); dividend of 10% on the ordinary shares, less tax, £1,250 (same); forward, £3,355 (£2,463).

British Piston Ring Company—Profit for the year to July 31, after charging depreciation and taxation, and including dividends from subsidiary companies, £55,977 (£57,298); to reserve for deferred repairs, maintenance and contingencies, £20,000 (nil); dividend of 20% (25%) on the ordinary stock; forward, £39,296 (£37,320).

Birmingham Small Arms Company—Dividends on the "A" and "B" preference stocks for the six months ended July 31, and an interim dividend of 7½% actual, less tax, on the ordinary stock in respect of the year (same). No further dividends will be recommended or paid on the ordinary stock in respect of that year.

OBITUARY

MAJOR ARTHUR D. STEEL, of Rutherglen, late of Stewarts and Lloyds, Limited, has been killed in action in the Central Mediterranean area.

SIR PHILIP BEALBY RECKITT, who died at his home in Sussex on November 17, aged 71, was chairman of Priestman Bros., Limited, engineers, of Hull.

MR. WILLIAM HENRY BRIDGES, who was employed for 50 years by Ibbotson Bros. & Company, Limited, Globe Steelworks, Sheffield, died on November 19, aged 74.

MR. CHARLES WRIGHT, who worked for Thos. Firth & John Brown, Limited, Sheffield, for 66 years, has died at the age of 79. He joined the firm in 1878 and worked as a roller until his retirement last March.

MR. ALBERT EDWARD SHORTER, managing director of Shorter Process Company, Limited, Sheffield, died suddenly on November 18. He invented a process of flame hardening and formed the Patent Gear & Metal Hardening Company, Limited, to develop it. Later the Shorter Process Company, Limited, was formed. Former president of the Institution of Welding Engineers, he was also a member of the Institution of Mechanical Engineers.

SIR MAURICE HUGH LOWTHIAN BELL, BT., of Mount Grace Priory, Northallerton, a director of Dorman, Long & Company, Limited, died on November 17 at Newcastle-upon-Tyne. He was 73 years of age. Sir Maurice was a director of Bell Bros., Limited, proprietors of the Clarence Ironworks, originally established by his grandfather, the late Sir Lowthian Bell, Bt. He became a director of Dorman, Long & Company on the amalgamation of the two companies. He was Deputy Lieut. of the North Riding in 1895, and Sheriff of Durham County in 1921. He saw active service in the South African war, and again in the last world war, when he was Lieut.-Col. of the 4th Battn. Green Howards. Sir Maurice was specially interested in and a generous benefactor of the youth movement

COMMANDER SIR CHARLES CRAVEN, BT., chairman and managing director of Vickers-Armstrongs, Limited, and Industrial Adviser to the Minister of Production, died on November 18. He was born in 1884. In addition to Vickers-Armstrongs, he was chairman of the English Steel Corporation, Limited, Michell Bearings, Limited, Palmers Hebburn Company, Limited, and other companies; he was also deputy-chairman and managing director of Vickers, Limited, and a director of Firth-Vickers Stainless Steels, Limited, and Guest, Keen Baldwin's Iron & Steel Company, Limited. Sir Charles was a past-president of the British Employers' Confederation and the Engineering and Allied Employers' National Federation and chairman of the Industrial Welfare Society. He was knighted in 1934, and created a baronet in 1942. He entered the Royal Navy as a cadet, and became an expert in under-water craft, volunteering for the Submarine Service in its early days.

Raw Material Markets

IRON AND STEEL

The pig-iron market is listless and inert. A few of the light foundries have a little more work in hand, and are buying high-phosphorus iron to cover their visible needs, but a very limited tonnage is represented in recent transactions, and the present restricted output is adequate for current needs. Nevertheless, possibilities of more difficult conditions cannot be wholly excluded. A commencement of the housing programme should not be much longer delayed, and provision of additional tonnages of pig-iron for the light-castings industry may be difficult. No lack of ironstone or limestone need be apprehended, and blast-furnace capacity is adequate, but supplies of coke no more than suffice for current needs, and it may be difficult to provide the extra fuel if the need should arise to increase the output of foundry iron. The production of refined iron and of low- and medium-phosphorus grades is adequate for the lessened requirements of the general engineering and allied foundries, but the scarcity of hematite persists and licences are only issued for specially authorised purposes.

The foundries are, at the moment, experiencing no difficulty in securing all the scrap they need. Steelworks, also, are able to fill their needs, though the proportion of light scrap on offer at the moment is rather large, and they would welcome increased supplies of heavy scrap.

Requests for steel semis are still on a substantial scale. Although business recently has been less brisk, the re-rollers still have healthy order-books, and are using big tonnages of slabs, blooms, billets, sheet bars, wire rods, etc. Apart from the scarcity of small sizes of billets, the Control is taking good care that sufficient material is available to avoid any interruption of the operations of the independent mills. Nevertheless, the semi-finished steel position calls for vigilance, and the re-rollers miss no opportunity of buying up any other class of material, such as crops, defectives, or discard steel which becomes available.

There is little change in the position of heavy steel products. Activity in the locomotive and wagon shops does not compensate for the downward trend in the shipbuilding industry. This is possibly only a temporary phase, but at present shipbuilders are specifying relatively small tonnages of plates, and the mills are fully employed. There is a marked contrast in the position of the mills rolling sectional material. Specifications for heavy joists and channels are particularly scarce, whereas the small bar and light section mills have two or three months' work in hand. Pressure for colliery supplies is unabated, but makers of special steels report a quieter demand than at any time during the past three or four years.

Hattersley (Ormskirk)—Interim dividend of 6% (same).

NON-FERROUS METALS

Although the authorities are viewing more favourably applications for licences to acquire non-ferrous metals, so far only a relatively small tonnage has gone into the manufacture of civilian goods. Zinc is now freely available for galvanising, and its use is being permitted in the building industry. Lead is also being released more generously for building construction and repair. Copper and brass are being used to a greater extent, but here, again, licences granted are mainly in connection with building activities. Aluminium is much more plentiful, both in this country and on the other side of the Atlantic. The metal is now available for a good many purposes outside the manufacture of war goods, and it is believed that it may be possible to arrange for export. In the United States authority has been granted to manufacture a considerable tonnage of aluminium ware. The falling off in British orders for Canadian aluminium, it is believed, will result in a substantial reduction of output in that country.

Considerable interest is being shown in a report that an international copper conference is contemplated. The aims, presumably, would be to secure price stability mainly and, possibly, would entail some kind of control over output.

Some classes of non-ferrous metals scrap, including brass swarf, have risen in price recently, but there is no indication that this is the beginning of an upward turn in the prices of metal scrap generally.

ENGINEERING COMPANIES' SHARES

The shares in several manufacturing companies, bought during the war by the Minister of Supply, are to be sold by the Ministry to "approved buyers." The share capital of a number of companies was acquired in order to protect vital war production, and the Ministry announces that, with the changing programme of war production, the necessity to retain control of some of these companies has now passed.

The companies for the shares of which the Minister is prepared to consider applications to purchase are:—

Bren Manufacturing Company—Issued capital, £20,000; loan capital, £50,000.

John Fowler & Company (Leeds), Limited—Issued capital, £200,000.

John Stirk & Sons—Issued capital, £20,000; loan capital, £30,000.

Industrial & Mechanical Engineers, Limited—Issued capital, £18,000.

Melbourne Engineering Company (Melbourne), Limited—Issued capital, £5,000; loan capital, £80,000.

Intending purchasers should approach the Director of Finance (Commercial) at the Ministry of Supply, Adelphi, London, W.C.2, not later than December 22.

SIR SAMUEL OSBORN, of Samuel Osborn & Company, Limited, Clyde Steel Works, Sheffield, has been re-elected to the Council of the Industrial Welfare Society.

CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, November 29, 1944

PIG-IRON

Foundry Iron.—CLEVELAND No. 3: Middlesbrough, 128s.; Birmingham, 130s.; Falkirk, 128s.; Glasgow, 131s.; Manchester, 133s. DERBYSHIRE No. 3: Birmingham, 130s.; Manchester, 133s.; Sheffield, 127s. 6d. NORTHANTS No. 3: Birmingham, 127s. 6d.; Manchester, 131s. 6d. STAFFS No. 3: Birmingham, 130s.; Manchester, 133s. LINCOLNSHIRE No. 3: Sheffield, 127s. 6d.; Birmingham, 130s.

(*No. 1 foundry 3s. above No. 3. No. 4 forge 1s. below No. 3 for foundries, 3s. below for ironworks.*)

Hematite.—Si up to 3.00 per cent., S & P 0.03 to 0.05 per cent.; Scotland, N.-E.Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, 140s. 6d., delivered Birmingham.

Scotch Iron.—No. 3 foundry, 124s. 9d.; No. 1 foundry, 127s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, 174s.; South Zone, 176s. 6d.

Refined Malleable.—North Zone, 184s.; South Zone, 186s. 6d.

Cold Blast.—South Staffs, 227s. 6d.

(NOTE.—*Prices of hematite pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton.*)

FERRO-ALLOYS

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

Ferro-silicon (5-ton lots).—25 per cent., £21 5s.; 45 per cent., £25 10s.; 75 per cent., £39 10s. Briquettes, £30 per ton.

Ferro-vanadium.—35/50 per cent., 15s. 6d. per lb. of V.

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

Ferro-titanium.—20/25 per cent., carbon-free, 1s. 3½d. lb.

Ferro-tungsten.—80/85 per cent., 9s. 8d. lb.

Tungsten Metal Powder.—98/99 per cent., 9s. 9½d. lb.

Ferro-chrome.—4/8 per cent. C, £46 10s.; max. 2 per cent. C, 1s. 3¾d. lb.; max. 1 per cent. C, 1s. 4¼d. lb.; max. 0.5 per cent. C, 1s. 6d. lb.

Cobalt.—98/99 per cent., 8s. 9d. lb.

Metallic Chromium.—96/98 per cent., 4s. 9d. lb.

Ferro-manganese.—78/98 per cent., £18 10s.

Metallic Manganese.—94/96 per cent., carb.-free, 1s. 9d. lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.—BASIC: Soft, u.t., 100-ton lots, £12 5s.; tested, up to 0.25 per cent. C, £12 10s.; hard (0.42 to 0.60 per cent. C), £13 17s. 6d.; silico-manganese, £17 5s., free-cutting, £14 10s. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £15 15s.; case-hardening, £16 12s. 6d.; silico-manganese, £17 5s.

Billets, Blooms and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £13 17s. 6d.; basic hard, 0.42 to 0.60 per cent. C, £14 10s.; acid, up to 0.25 per cent. C, £16 5s.

Sheet and Tinplate Bars.—£1 2s. 6d. 6-ton lots.

FINISHED STEEL

[*A rebate of 15s. per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.*]

Plates and Sections.—Plates, ship (N.-E. Coast), £16 3s.; boiler plates (N.-E. Coast), £17 0s. 6d.; chequer plates (N.-E. Coast), £17 13s.; angles, over 4 un. ins., £15 8s.; tees, over 4 un. ins., £16 8s.; joists, 3 in. × 3 in. and up, £15 8s.

Bars, Sheets, etc.—Rounds and squares, 3 in. to 5½ in., £16 18s.; rounds, under 3 in. to ⅝ in. (untested), £17 12s.; flats, over 5 in. wide, £15 13s.; flats, 5 in. wide and under, £17 12s.; rails, heavy, f.o.t., £14 10s. 6d.; hoops, £18 7s.; black sheets, 24 g. (4-ton lots), £22 15s.; galvanised corrugated sheets (4-ton lots), £26 2s. 6d.; galvanised fencing wire, 8 g. plain, £26 17s. 6d.

Tinplates.—I.C. cokes, 20 × 14 per box, 29s. 9d. f.o.t. makers' works, 30s. 9d., f.o.b.; C.W., 20×14, 27s. 9d., f.o.t., 28s. 6d., f.o.b.

NON-FERROUS METALS

Copper.—Electrolytic, £62; high-grade fire-refined, £61 10s.; fire-refined of not less than 99.7 per cent., £61; ditto, 99.2 per cent., £60 10s.; black hot-rolled wire rods, £65 15s.

Tin.—99 to under 99.75 per cent., £300; 99.75 to under 99.9 per cent., £301 10s.; min. 99.9 per cent., £303 10s.

Spelter.—G.O.B. (foreign) (duty paid), £25 15s.; ditto (domestic), £26 10s.; "Prime Western," £26 10s.; refined and electrolytic, £27 5s.; not less than 99.99 per cent., £28 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £25; ditto (Empire and domestic), £25; English, £26 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, ex works, £37 12s. 6d.; rolled zinc (boiler plates), ex works, £35 12s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £30 10s.

Other Metals.—Aluminium, ingots, £110; antimony, English, 99 per cent., £120; quicksilver, ex warehouse, £68 10s. to £69 15s.; nickel, £190 to £195.

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16s.; rods, drawn, 11⅜d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 11⅛d.; wire, 10⅞d.; rolled metal, 10½d.; yellow metal rods, 9d.

Copper Tubes, etc.—Solid-drawn tubes, 15¼d. per lb.; brazed tubes, 15¼d.; wire, 10d.

Phosphor Bronze.—Strip, 14¼d. per lb.; sheets to 10 w.g.; 15¼d.; wire, 16½d.; rods, 16½d.; tubes, 21½d.; castings, 20d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 10d. to 1s. 4d. per lb.; rolled to 9 in. wide, 1s. 4d. to 1s. 10d.; to 12 in. wide, 1s. 4¼d. to 1s. 10¼d.; to 15 in. wide, 1s. 4½d. to 1s. 10½d.; to 18 in. wide, 1s. 5d. to 1s. 11d.; to 21 in. wide, 1s. 5½d. to 1s. 11½d.; to 25 in. wide, 1s. 6d. to 2s. Ingots for spoons and forks, 10d. to 1s. 6½d. Ingots rolled to spoon size, 1s. 1d. to 1s. 9½d. Wire, round, to 10g., 1s. 7½d. to 2s. 2½d., with extras according to gauge. Special 5ths quality turning rods in straight lengths, 1s. 6½d. upwards.

NON-FERROUS SCRAP

Controlled Maximum Prices.—Bright untinned copper wire, in crucible form or in hanks, £57 10s.; No. 1 copper wire, £57; No. 2 copper wire, £55 10s.; copper firebox plates, cut up, £57 10s.; clean untinned copper, cut up, £56 10s.; braziery copper, £53 10s.; Q.F. process and shell-case brass, 70/30 quality, free from primers, £49; clean fired 303 S.A. cartridge cases, £47; 70/30 turnings, clean and baled, £43; brass swarf, clean, free from iron and commercially dry, £34 10s.; new brass rod ends, 60/40 quality, £38 10s.; hot stampings and fuse metal, 60/40 quality, £38 10s.; Admiralty gunmetal, 88-10-2, containing not more than ½ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin, £77, all per ton, ex works.

Returned Process Scrap.—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended Nov. 25, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

Brass.—S.A.A. webbing, £48 10s.; S.A.A. defective cups and cases, £47 10s.; S.A.A. cut-offs and trimmings, £42 10s.; S.A.A. turnings (loose), £37; S.A.A. turnings (baled), £42 10s.; S.A.A. turnings (masticated), £42; Q.F. webbing, £49; defective Q.F. cups and cases, £49; Q.F. cut-offs, £47 10s.; Q.F. turnings, £38; other 70/30 process and manufacturing scrap, £46 10s.; process and manufacturing scrap containing over 62 per cent. and up to 68 per cent. Cu, £43 10s.; ditto, over 58 per cent. to 62 per cent. Cu, £38 10s.; 85/15 gilding metal webbing, £52 10s.; 85/15 gilding defective cups and envelopes before filling, £50 10s.; cap metal webbing, £54 10s.; 90/10 gilding webbing, £53 10s.; 90/10 gilding defective cups and envelopes before filling, £51 10s.

Cupro Nickel.—80/20 cupro-nickel webbing, £75 10s.; 80/20 defective cups and envelopes before filling, £70 10s.

Nickel Silver.—Process and manufacturing scrap; 10 per cent. nickel, £50; 15 per cent. nickel, £56; 18 per cent. nickel, £60; 20 per cent. nickel, £63.

Copper.—Sheet cuttings and webbing, untinned, £54; shell-band plate scrap, £56 10s.; copper turnings, £48.

IRON AND STEEL SCRAP

(*Delivered free to consumers' works. Plus 3½ per cent. dealers' remuneration. 50 tons and upwards over three months, 2s. 6d. extra.*)

South Wales.—Short heavy steel, not ex. 24-in. lengths, 82s. to 84s. 6d.; heavy machinery cast iron, 87s.; ordinary heavy cast iron, 82s.; cast-iron railway chairs, 87s.; medium cast iron, 78s. 3d.; light cast iron, 73s. 6d.

Middlesbrough.—Short heavy steel, 79s. 9d. to 82s. 3d.; heavy machinery cast iron, 91s. 9d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 89s. 3d.; medium cast iron, 79s. 6d.; light cast iron, 74s. 6d.

Birmingham District.—Short heavy steel, 74s. 9d. to 77s. 3d.; heavy machinery cast iron, 92s. 3d.; ordinary heavy cast iron, 87s. 6d.; cast-iron railway chairs, 87s. 6d.; medium cast iron, 80s. 3d.; light cast iron, 75s. 3d.

Scotland.—Short heavy steel, 79s. 6d. to 82s.; heavy machinery cast iron, 94s. 3d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 94s. 3d.; medium cast iron, 77s. 3d.; light cast iron, 72s. 3d.

(Note.—*For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less.*)

SITUATIONS

GENTLEMAN, with 20 years' experience in whiteheart malleable founding, desires progressive position, with good post-war prospects; prepared to consider capital investment.—Box 784, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

ESTIMATING, ETC. — Practical Foundryman, with technical training, desires post on Commercial side; 14 years' experience estimating, rate fixing, planning and layout on competitive jobbing work, machine, plate, and loose patterns, including patternmaking.—Box 748, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY PLANNING ENGINEER seeks position as Foundry Manager; age 33; practical and technical training; expert repetition; fully mechanised plant, grey and malleable iron, also alloy steels; disciplinarian and good organiser; guarantee results.—Box 788, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

METALLURGIST, M.I.B.F., M.Inst.Met., specialised non-ferrous foundry problems and planning, offers free-lance services and facilities for investigations.—Box 792, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

AN attractive permanent post is available for an experienced practical Foundry Superintendent; to take complete charge of foundry, and possibly also of patternshop, for producing 25 tons per week of high-class grey iron Machinery Castings; in South Lancashire; applicants should be under 50 years of age.—Write, in confidence, giving full details of experience and salary required, to Box 790, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY MANAGER required for jobbing and mechanised foundry; high-class alloy steels; must be accustomed to strict technical control and up-to-date methods of progress and planning, and a good disciplinarian; good prospects for first-class man of proved ability.—Full details of experience, etc., to Box 794, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

A POSITION will shortly be available for a Head Foreman to take full control of production in a small Malleable and Grey Iron Foundry in South Yorkshire; must have practical experience of plate and light machine moulding for products up to 20-30 lbs. weight, of rate fixing, annealing of whiteheart and cupola melting; permanent post-war position for suitable man.—Write, giving details of age, experience, and salary expected, to Box 786, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOREMAN required for small Iron Foundry, North Midlands; must be practical moulder, with good knoweldge of green sand, dry sand, and loam moulding of high iron castings up to 4 tons weight, with clean smooth finish.—Full particulars, giving age, experience, and salary required, to the Manager, MINISTRY OF LABOUR AND NATIONAL SERVICE, Employment Exchange, Belper, Derbyshire.

SALES REPRESENTATIVE for London and Home Counties, on commission basis, required by well-known manufacturers of Foundry Supplies; good knowledge of the foundry trade essential—Write offers, with details, to Box ZK.904, DEACON'S, 5, St. Mary Axe, London, E.C.3.

EMPLOYMENT REGISTER.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

FOUNDRY METALLURGIST (32), B.Sc., M.I.B.F., with 8 years' experience of electric steel production, cupola operation, heat-treatment, control of chemical and physical laboratories, and accustomed to Lloyds and departmental inspection, desires similar position. Technical teaching experience could be applied to apprenticeship schemes. (464)

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SOUTH Wales Merchants, established over 50 years, seek Agencies for Supplies to Steel and Tinplate Works and Collieries.—Reply to Box 744, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

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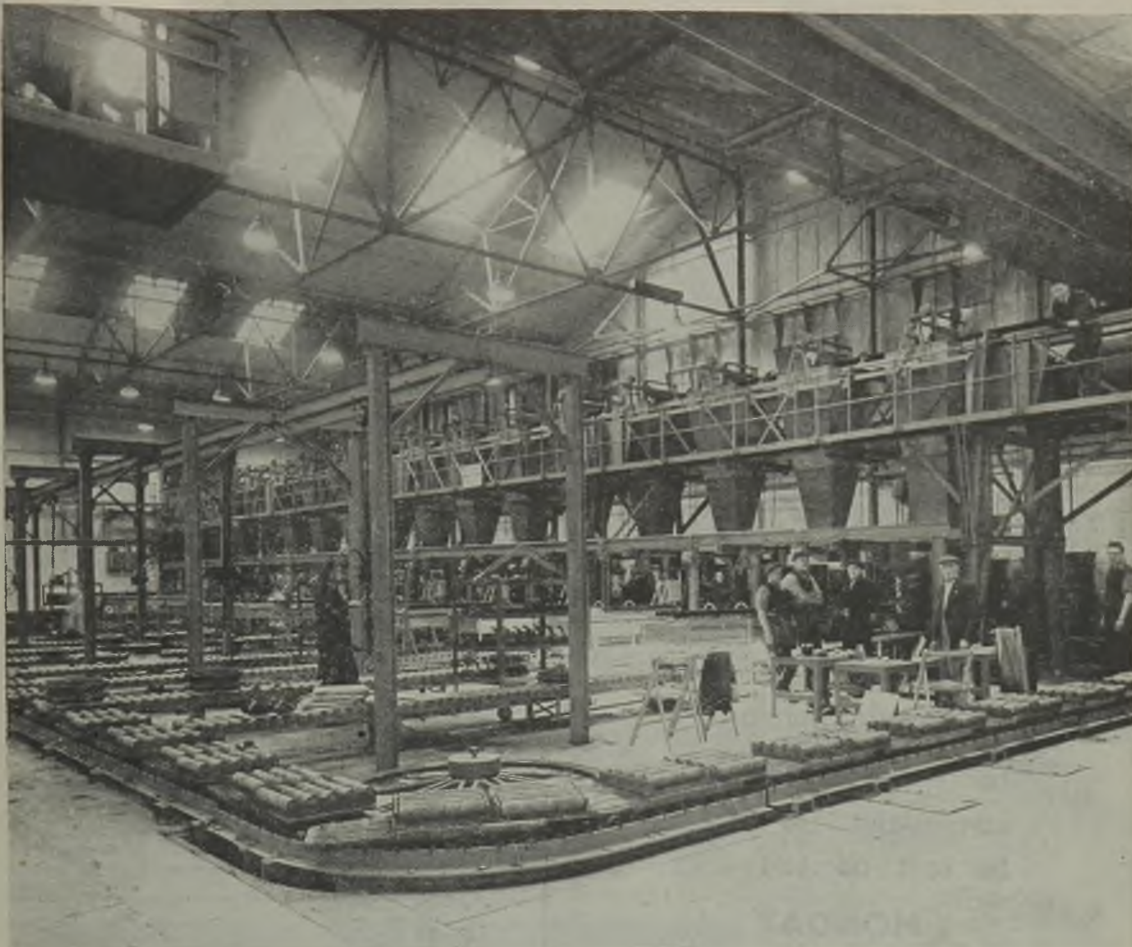

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