A New Theory of the Cast Irons.

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(see figs)

OF the papers submitted to the Iron and Steel Institute at its recent meeting on Sept. 20-22 in Glasgow, one at any rate stands out as a contribution of far more than usual interest. Carbon may exist in the unhardened irons and steels in the free state, in all probability as graphite, or combined with the iron as the carbide Fe_3C. In the steels the latter form is almost invariably the one present, while in the grey irons it is graphite. The relationship of these two forms has been by no means cleared up, though in general it has been assumed that in the stable condition the solid material would contain the carbon in the graphitic form, the carbide being a metastable constituent. This is represented in thermal equilibrium diagrams by superposing the one for the graphitic metal upon that for alloys containing carbide. This double diagram has been admittedly incomplete and unsatisfactory, and a noteworthy contribution is made to the subject by Prof. D. Hanson, who, on both experimental and theoretical grounds, now offers a single diagram in which phase fields are deliminated in which both types of carbon are to be found.

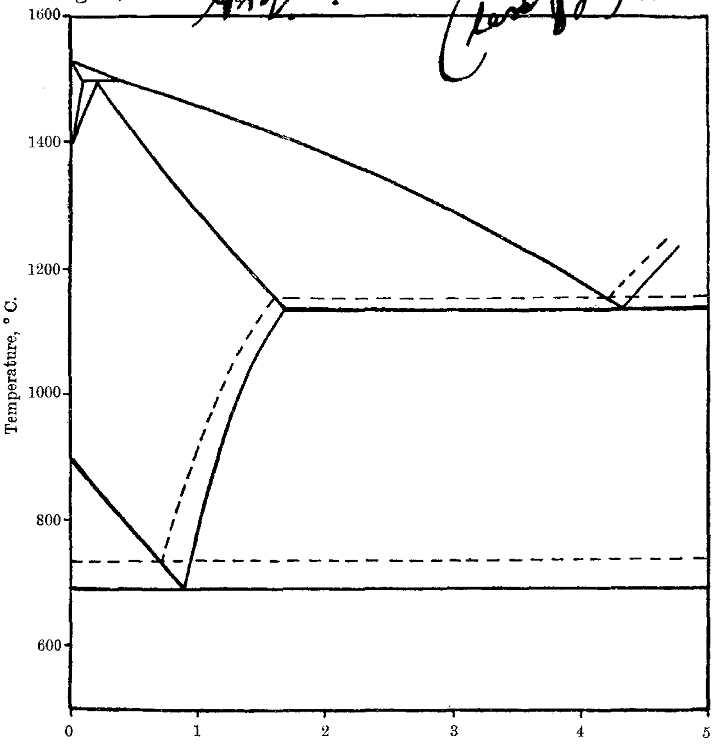

Fig. 1.[1]

The most generally accepted diagram, that in which both the iron–carbon and the iron carbide equilibria are independently shown suggested by Roozeboom, Benedicks, and others, is shown in Fig. 1.[1] Graphite is represented as the stable phase at all temperatures below the solidus, and the dotted lines in the figure represent, therefore, the graphite equilibrium. Alternatively, Rosenhain has suggested that the carbide equilibrium is the stable one. Prof. Hanson has now considered the results which would follow from a change over from one system to the other as the temperature is varied. If, for example, graphite is the stable form at temperatures up to, say, 1000° C. and carbide stable at higher ones, then the dotted line separating the austenitic phase from one in which free graphite or carbide also exists must cross the ordinary cementite line at that temperature, and thence onwards up to the solidus will lie to the right. As a result, a type of diagram similar to that of Fig. 2 will be found. It is, perhaps, right to point out that although the advance copy of Prof. Hanson's paper does not refer to the fact, some such suggestion has already been put forward by Honda.

The normal cast irons and steels are not, however, pure binary alloys and represent sections through at least a ternary model, silicon being for the present purpose the most important addition. Where the amount of this is insufficient to cause the introduction of a new phase its effects upon a diagram such as Fig. 2 are considered, and in the light of the experimental evidence obtained, it is shown that these results can be represented completely by a diagram of the form of Fig. 3 and by no other.

It is yet too early to say how completely the new hypothesis and diagram fit in with all the established facts regarding the relationships of iron, graphite, and carbide.

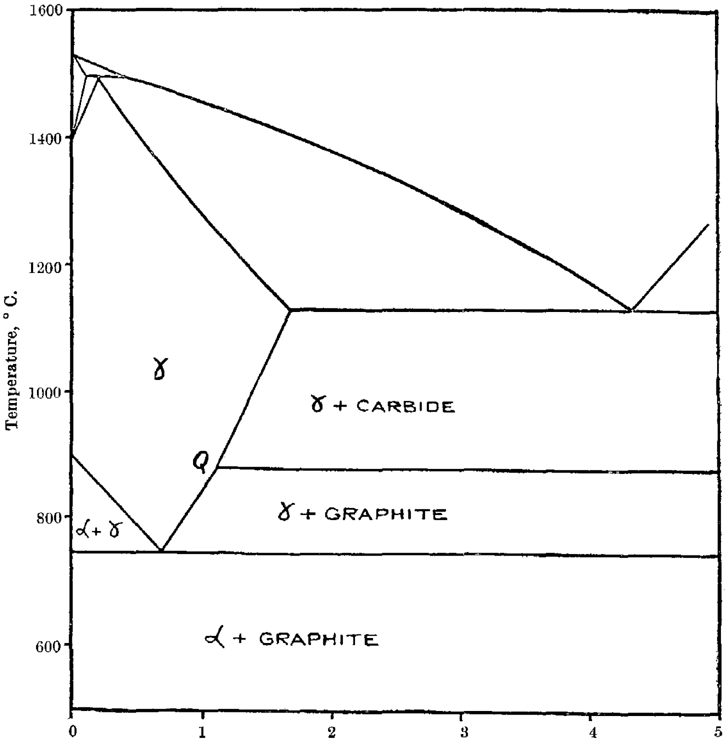

Fig. 2.

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[1] This and the other illustrations are reproduced by courtesy of the Iron and Steel Institute.

Certain facts regarding the presence of graphite in carbon steels, particularly those which have been cold worked, do not appear to be altogether in accord with the new ideas, but this is probably merely a question of the exact position of the limits of the phase fields. To Dr. Hanson the credit is due for opening up possibly an almost undreamed-of simplification of existing notions concerning these hitherto very complicated materials. F. C. T.

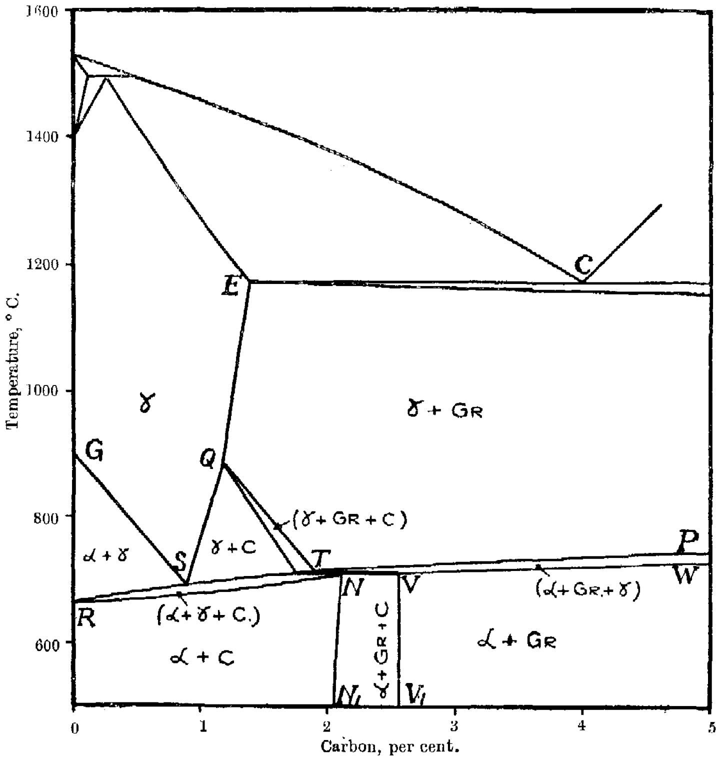

FIG. 3.

Aeronautical Research in Great Britain.[1]

THE steady advance which has shown itself in all aspects of aeronautical research since the inception of the Aeronautical Research Committee is marked by the appearance of the report for the year 1926-27. It is a standing tribute to the work which may be done by a team of steady, earnest workers marshalled in their activities to a definite end.

It is difficult to separate out the investigations by placing them in separate categories, for a considerable amount is of a general nature and overlaps into several fields. Broadly speaking, however, the work of investigation deals with aerodynamics, airships, engines, and materials, but each of these is itself a composite group.

There are numerous papers dealing with the measurement of performances of aeroplanes, especially with the newer method introduced at Martlesham, by Lieut. Capon. In air-screws the impact of the Lanchester-Prandtl theory of fluid motion makes itself apparent in a series of papers by Glauert and Lock. Here a difficult subject is being pushed several stages further. A problem to which members of the research staffs concerned have devoted close study is that of generation and avoidance of spinning in aeroplanes, and this year sees the production of a considerable volume by Gates and Bryant, where the whole of the subject is discussed in the form of a special monograph. For those who strive to retain contact with this rapidly developing subject, this new departure by the Aeronautical Research Committee of summarising in this form at stages the work which has been accomplished is to be highly commended. The further development of the subject by the complete representation of a spin in the wind tunnel is progressing. It is hoped that this work, in conjunction with detailed records of the motion of spinning aeroplanes taken at the R.A.E., will elucidate those points which are still obscure.

The suspicion that recent aeroplane accidents have been associated with wing flutter has constrained the Committee to set up a special section for the investigation of this problem. At the National Physical Laboratory, Teddington, it is now possible to demonstrate at will various types of flutter that have been experienced in flight. The problem of determining the aerodynamic characteristics of aircraft during flutter is still the subject of investigation, but certain recommendations for the avoidance of dangerous vibrations in future aircraft have already been put forward, and modifications to existing types of aeroplanes exhibiting this phenomenon have been suggested with the view of its suppression.

A new departure is seen in the development of a tailless aeroplane by Captain Hill. While various experimental difficulties had been experienced with the lightly loaded aeroplane of this type, these have now been overcome, and some development may be looked for in the near future. It is reported that this aeroplane is quite stable and controllable in flight at large angles of incidence.

On the purely scientific side, some interesting experiments are detailed on the two-dimensional airflow behind a flat plate inclined at various angles. Studies are made of the frequency and velocity with which the individual vortices pass down stream and measurements are made of vortex strength. The results show a very fair agreement with Karman's formula, the longitudinal spacing of the vortices remaining constant for a distance of several plate widths down wind.

Meanwhile, at Cambridge, an experimental water-tank has been erected, in which two-dimensional bodies are towed through water. By this means a Reynolds' number of approximately 10^4 has been obtained, and it is hoped to produce results shortly with numbers so high as 5×10^5. Thus an approach is being made to the corresponding number for normal flight, namely, 3×10^6.

While stress has here been laid on the aerodynamic side of this year's report, this is done merely to indicate the kind of advance which shows itself in all the other sections under the influence of systematic and co-ordinated research work. As an experiment in organised research, the Aeronautical Research Committee may in many respects be taken as a model.

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[1] "Report of the Aeronautical Research Committee for the year 1926-27." (London: H.M. Stationery Office, 1927.) 2s. net.