Monaco Conference on Corrosion

A VERY successful conference on corrosion was held at Monaco on March 25–27 under the direction of the Académie Méditérranéenne. It was attended by most of the French authorities on corrosion and by a number of delegates from other countries; the latter included Sir Robert Hadfield and Prof. S. M. Dixon, representing the Institution of Civil Engineers, Dr. J. C. Hudson, representing the Corrosion Committee of the Iron and Steel Institute, Prof. J. Timmermans, of Brussels, and Prof. T. O. Rotini, of Milan. Although, apart from one or two original contributions, most of the papers presented dealt with investigations already undertaken or completed by the various authors, they may be taken as representing the general trend of thought as regards corrosion problems in French circles. It may, therefore, be of interest to communicate some of their most interesting features.

The inaugural session was opened by a communication from General C. Grard, who is the chairman of the Corrosion Committee of the French Air Ministry. This Committee is primarily concerned with the corrosion of such metals and alloys as are, or may be, used in aircraft. Thus, for some time after its formation in 1926, its work was confined to a study of the corrosion of light alloys, but its field of research was extended in 1929 to include such ferrous metals as are of interest in aircraft construction. This Committee has a central organization of its own[1] and is also responsible for sponsoring research work in the laboratories of French universities, for example, at Lille, where Prof. Chaudron and his pupils have been conducting fundamental and practical work of great importance for a number of years. In addition, researches are undertaken in industrial laboratories, but it would appear, from conversation with several French workers in this field, that industrial collaboration in this respect is not yet quite so advanced as in Great Britain, where as a result of the influence of the Department of Scientific and Industrial Research and the formation of research associations, there is a very real and effective co-operation between individual firms in many industries.

The necessity for much closer co-operation in industrial research is generally recognized in France, and was alluded to on at least two occasions in the course of the conference. For example, *M.* Michel, of Messrs. Jacob Holtzer, raised the question at the conclusion of his communication on the properties of certain stainless steels, and his appeal for closer collaboration in research on corrosion work was warmly received by the other delegates. It may be added that organized researches on corrosion in France are also being fostered by the Office Technique pour l'Utilisation de l'Acier, although little information about this work has yet been published.

General Grard was followed by Sir Robert Hadfield, who commenced by paying a warm tribute to the memory of his old friend, Prof. Henry le Chatelier. Sir Robert then referred to the researches on corrosion fostered by the Institution of Civil Engineers, in which he has been actively interested since their inception in 1916, and to his investigations of wrought iron samples taken from the Delhi pillar. British field tests on corrosion were also described by Dr. J. C. Hudson, who dealt more particularly with atmospheric corrosion and the work of the Iron and Steel Institute Corrosion Committee.

The biological and particularly the bacteriological aspects of corrosion were prominent features of the conference. This subject was discussed during the opening session in a paper presented by *M.* R. Legendre, the director of the Laboratoire Maritime du College de France at Concarneau, who has been interested in corrosion research for some fifteen years[2] and in particular has been responsible for numerous field tests on marine corrosion conducted at Concarneau. In the course of some experiments on painted steel specimens exposed to complete immersion in a tidal basin at this port, a peculiar type of corrosion was observed underneath the paint. Local deposits of black mud were found between the paint and the steel, below which the steel was brilliantly etched, as if by acid. Samples of this mud were subjected to a bacteriological examination in the Pasteur Institute by *M.* Veillon, who was able to isolate from it a number of distinct types of aerobic and anaerobic bacteria. Laboratory experiments, in which samples of bare or of painted steel were exposed to corrosion in a suitable medium inoculated with various cultures of these bacteria, showed conclusively that the anaerobic bacteria or the anaerobic bacteria acting in symbiosis with the aerobic bacteria promoted corrosion of the steel, as compared with the behaviour of blank specimens exposed in the sterile medium; the aerobic bacteria alone had no effect. A black corrosion product was formed which had a characteristic smell similar to that of the original mud and was considered to be iron sulphide, since analysis showed that it contained both iron and sulphur[3].

References were also made to interesting researches on protective paints conducted in the laboratories of the Office National des Recherches et Inventions at Bellevue by *M.* A. Vila and his colleagues. These have resulted in the development of an accelerated weathering test for paints and of coal tar paints pigmented with flake aluminium. The accelerated test[4] is peculiar in that the French workers have been led by their experience to abandon exposure to ultra-violet light, which is so prominent a feature of most types of accelerated testing apparatus for paints, and to rely on a wide variation in the range of temperature and of the corrosive media to which the specimens are exposed. The aluminium tar paints[5], which are not unknown in Great Britain, consist essentially of a tar medium to which suitable thinners and about fifteen per cent of aluminium pigment have been added, although, according to *M.* Coret, of the Paris Gas Company, twelve per cent of pigment should suffice. *M.* Coret also stressed the fact that the choice of a suitable tar is of great importance and that the presence of compounds that are capable of being readily nitrated is injurious, whilst Dr. J. Roux claimed, probably with justice, that these paints have inhibitive properties.

Another interesting paper was presented by *M.* F. Canac, the scientific director of the Laboratoire du Centre d'études de la Marine at Toulon, who summarized and extended the results of his work on the topography of corrosion[6]. *M.* Canac has utilized an optical method to investigate the character of the attack on a corroded surface; briefly, the method consists in studying the distribution in space of the light diffused from a corroded surface, the angle of incidence being varied. He has shown by mathematical analysis that the diffusion/time curves at different angles of incidence should be characteristic for different types of attack, for example, for uniform corrosion spreading outwards at a constant rate from a regularly distributed number of centres, for intercrystalline corrosion, etc., and he has observed close approximations to the theoretical curves in actual corrosion experiments. This method and also one described by *M.* Nicolau for studying the roughness of a surface, depending on observations of the rate of escape of compressed air from a standard orifice brought into close proximity with it, should prove of value in the study of certain types of corrosion problems.

Prof. A. M. Portevin and Dr. E. Herzog communicated the results of some tests on the corrosion of a low alloy chromium-aluminium steel exposed to sea air and to immersion in sea-water at five different ports in France and Algeria[7]. It is encouraging to note that the results showed a marked superiority in the behaviour of the low alloy steel as compared with ordinary steels, not only in the atmospheric but also in the immersion tests. This observation may be of considerable practical importance, since the improvements effected so far in the corrosion resistance of steel by the addition of small amounts of alloying elements, without markedly increasing its cost, have not proved nearly so pronounced in the case of exposure to immersion in sea-water as in that of exposure to atmospheric corrosion.

Prof. G. Chaudron gave a general survey of his researches at Lille, which deal both with ferrous and with light alloys, and stressed the fact that studies of dissolution potential should include the behaviour not only of the bare metal but also of the metal covered with its oxide film. Prof. A. Travers of Nancy communicated the results of an examination of a cast iron pipe that had suffered severe graphitization whilst lying in the soil, and concluded, as is also the view of Dutch experts who have studied the problem, that bacteriological action plays an important part in this phenomenon; the reduction of calcium sulphate in the soil as a result of bacteriological action also formed the subject of a paper by Prof. R. O. Rotini, of Milan. It is also possible that an electrolytic method of polishing metals, devised by *M.* P. A. Jacquet[8] which, the author states, does not result in the formation of a Beilby layer or mechanical disturbance of the metal, may have other interesting applications besides its effect on the structure of electro-deposits, which he discussed.

It remains to add that the arrangements of the Conference were in the capable hands of *M.* J. Desthieux, the secretary of the Académie Méditerranéenne, that thirty papers were read or presented and that at the end of the Conference the proceedings were very ably summarized by *M.* Canac, who acted as *rapporteur*.

[1] Grard, C., *Métaux*, **9**, 291 (1934).
[2] Legendre, R., *Recherches et Inventions*, **17**, 29 (1937).
[3] Veillon, R., *Annales de l'Institut Technique du Bâtiment et des Travaux Publics*, **1**, 19 (1936).
[4] Vila, A., *Recherches et Inventions*, **17**, 79 (1936).
[5] Roux, J. *Métaux*, **10**, 509 (1935).
[6] Canac, F., *C.R.*, Jan. 3, 1933; Nov. 19, 1934; July 29, 1935.
[7] Portevin, A. M., and Herzog, E., *C.R.*, Dec. 14, 1936.
[8] cf. NATURE, **135**, 1076 (1935).

The Post Office Speaking Clock in Great Britain

UP to the beginning of the nineteenth century the time in most towns was taken from public clocks of various kinds, which occasionally varied appreciably from one another. This was a serious obstacle to the postal services, and led to the practice on mail coaches and trains of carrying chronometers to synchronize local post office clocks with a standard clock in London. Shortly after the introduction of the electric telegraph, electro-mechanical devices of various kinds were controlled by telegraphed signals. But it was not until 1874, a few years after the Government acquired the telegraph system, that successful distribution of the 10.00 a.m. Greenwich time signal was accomplished over sixty different lines. The development of this service into the very accurate International Time Signal transmitted from Rugby radio station at 10.00 and 18.00 G.M.T. daily was made in 1927. This service has the disadvantage of not always being available in the home. The well known six 'pips' of the B.B.C. have the disadvantage of being only available at certain times. Then came the synchronous motor-clocks running on frequency-controlled mains, but at present these clocks are far from being in universal use.

The success of 'speaking clocks' abroad, especially in Paris, encouraged the General Post Office to design a speaking clock service which would be of use to every house or shop connected with the P.O. telephones. It was decided that the inaccuracy of the clock should not exceed a tenth of a second, fast or slow, and that the time should be announced six times a minute, each announcement being followed by three audio-frequency pips, the last of which gives the exact time spoken. To hear the time a subscriber connected to an automatic exchange dials the code TIM, and one connected to a manual exchange asks for 'Time'.

A technical paper on this novel service was read to the Institution of Electrical Engineers on December 3 by Dr. E. A. Speight and O. W. Gill. They pointed out that when the exchange is called at, say, 10.25, a voice is heard saying, "At the third stroke it will be ten twenty-five and ten seconds". The third of the three pip sounds gives this time precisely. The next announcement will be ". . . . ten twenty-five and twenty seconds", and so on. Most recording systems may be classified as mechanical, magnetic or photographic in principle. The gramophone is typical of the instruments which give a mechanical record. It is compact and cheap to produce, but it has a fairly high noise level which increases steadily with the fairly rapid wear occurring in reproduction. Experiments on gramophone records made in India showed that it was necessary to replace them in one or two days time. Magnetic sound recording is done by means of a steel tape, but owing to its high velocity a considerable length of tape is required. In this case the initial quality