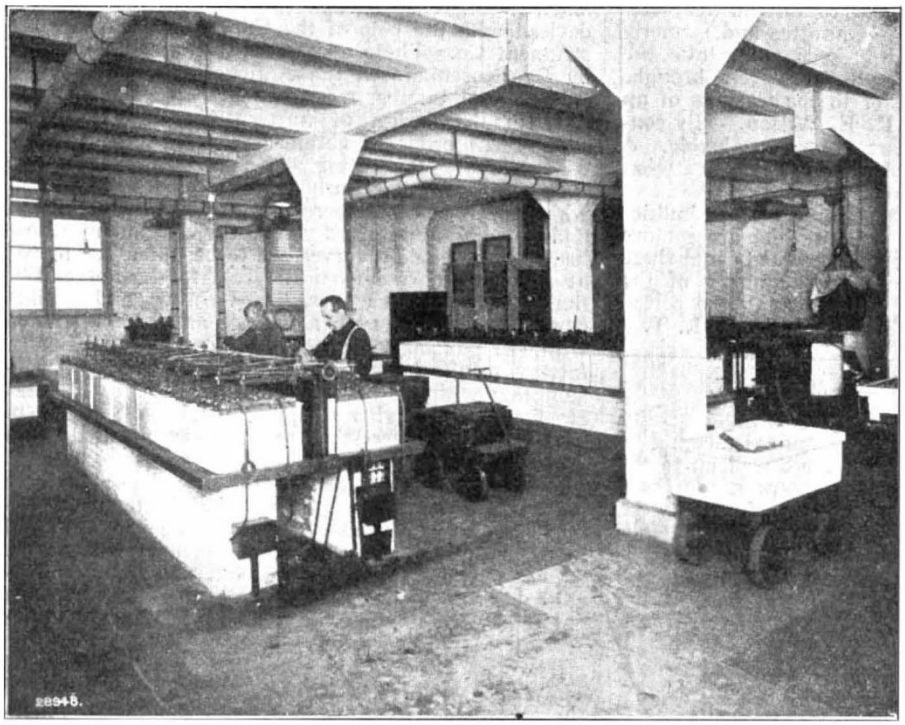
contains gold in the form of chloride and some free hydrochloric acid. Gold is dissolved at the anode, under the action of a current of electricity, and deposited in a pure state at the kathode. Other metals are also converted into chlorides at the anode, and either remain in solution, or pass into the anode slime. When silver is contained in the anode, it is converted into silver chloride which in part dissolves, in part falls to the bottom of the cell, and in part adheres to the anode, forming an insoluble coating. The result of the coating is that the free area of the anode is reduced, the density of the current becomes greater per unit area of effective anode surface, and chlorine is evolved unless a very small current is used. According to general experience, if more than 6 per cent. of silver is present in the bullion of the anode it is necessary to brush the silver chloride from the anodes, and accordingly this percentage is seldom exceeded in practice.



Photo] FIG. 1.—Electrolytic gold cells, United States Assay Office, New York. [*B. P. Wirth.*

The usual amount of free hydrochloric acid present in the bath varies from 3 to 10 per cent., but according to the results of experiments now put forward by Sir Thomas Rose some advantages are obtained by the use of stronger solutions. Thus in a bath containing 29 per cent. of free hydrochloric acid, a current of 5000 amperes per square metre of anode surface can be used without causing chlorine to be evolved at the anode. Under these conditions the proportion of silver in the anode may be raised to at least 20 per cent. without difficulties being encountered. The heavy current causes the silver chloride to split off from the anode, and also prevents gold from entering the anode slime, principally because no monochloride of gold is allowed to form.

Similar advantages occur in the deposition of gold at the kathode by the use of a solution containing 20 per cent. of gold as chloride instead of the usual 3 to 5 per cent. With a current of 5000 amperes per square metre, the gold is deposited in a coherent form, which is easily washed, and is malleable after being melted. The density of current now employed in practice is below 1000 amperes per square metre, and the anodes occupy about a week in being dissolved. With a current of 5000 amperes, the anodes would be dissolved within the limits of a working day and a saving in interest, and in the difficulties of daily stock-taking, would be effected.

One of the merits of the electrolytic process is that the refined gold is always malleable and fit for use in the arts, and another is that any platinum contained in the gold is extracted. This is becoming of some importance in view of the high price of platinum and of the fact that nearly all rough gold bullion, including that from the Transvaal, is now known to contain that metal. According to the experience in the United States mints (Fig. 1), it is cheaper to refine gold by electrolysis than by sulphuric acid.

BIRD-MIGRATION IN 1913.[1]

WE have before us the ninth of a projected series of ten reports setting forth the imposing mass of data regarding bird-migration collected by the committee appointed for the purpose by the British Ornithologists' Club. Once the final volume, dealing with the autumn of 1913 and the spring of 1914, has appeared, we may expect a publication of greater importance, summarising the vast amount of material collected by ten years' labour. In the meantime no attempt is made to draw conclusions from the facts which are published, but a few points about the movements of 1912–13 may here be selected for notice.

The autumn of 1912 appears to have been remarkable for the early dates at which the migrations of several species began. Thus a swallow was noted at the Bell Rock Light in the Firth of Tay on July 4, and willow-warblers at the same place two days later. As early as June 25 a large flock of starlings had been seen flying west in the evening at Spurn Head Light. On the nights of July 14–15 and 15–16 swifts were recorded from the Lundy North Light (British Channel) and the Hanois Light (Channel Islands) respectively.

The great movements, however, do not seem to have begun until mid-October, and the migrations observed during the first three weeks of November were of extraordinary magnitude. Almost every night during that period half-a-dozen different light-stations record the passage of large numbers of birds, notably skylarks, starlings, and various species of Turdus.

[1] Report on the Immigrations of Summer Residents in the Spring of 1913; also Notes on the Migratory Movements and Records received from Light-houses and Light-vessels during the Autumn of 1912. (Bulletin of the British Ornithologists' Club, vol. xxxiv., December, 1914.)

The winter which followed was marked by comparatively high and uniform temperatures. Consequently many summer-visitant birds do not seem to have quitted some of the southern and western districts, while others were recorded as returning at unusually early dates. The spring immigration proper is stated to have lasted from March 6 until June 6, reaching its height between April 14 and May 11.

Attention is directed to the very long period covered by the immigrations of certain species as contrasted with those of others. On one hand we have swallow (March 8 to May 20), sand-martin (March 13 to May 15), chiff-chaff (March 6 to May 8), and wheatear (March 12 to May 12). On the other we have the reed-warbler (April 18 to May 5), wood-warbler (April 9 to May 11), and nightingale (April 13 to May 5).

A special feature of the report is the long list of records emanating from the Caskets Light in the Channel Islands. This station is exceptionally favourably situated, and was expected to furnish very important data. Unhappily, the committee had formerly been unable to induce the light-keepers to take the matter up. The desired result has been brought about, however, by the transfer to the Caskets of an enthusiast in the work, Mr. R. E. Wilson. His contributions to the present report are very valuable. A special summary of the records relating to this station is promised for the next report.

The publication under discussion is even bulkier than its recent predecessors, but the data are set out in the same clear and orderly manner. As usual there are numerous charts and a useful summary of the meteorological conditions prevailing during the period covered by the migration records A. L. T.

THE INSTITUTE OF METALS.

IN spite of the war, both the number and quality of the papers presented at the annual meeting of the institute on March 18 and 19 were well up to the average. Naturally, in the circumstances, the contributions were furnished mainly by what may be termed the "academic" workers in non-ferrous metallurgy. Moreover, although the attendance of members was small, the discussions were always interesting and well-sustained. Unfortunately the president of the institute, Engineer Vice-Admiral Sir Henry Oram was prevented by his onerous official duties at Whitehall from presiding at the proceedings, and his place was filled at the last moment by one of the vice-presidents.

The paper by Prof. A. C. Huntington, on the effects of heat and of work on the mechanical properties of metals, gave rise to an interesting debate, and a spirited reply by the author. It describes a machine devised by him several years ago for the purpose of investigating these effects while the metals are being subjected to alternating bending stresses, such as occur in the firebox of a locomotive. No attempt was made to reproduce the somewhat complicated movements which occur there, but the metal or alloy was held rigidly at one end, and "subjected to a to and fro movement at the other end in a single plane at right angles to its axis." Both as regards the extent of the movement and the range of temperature investigated, the experiments were made to conform broadly to the kind of conditions that obtain in locomotive fireboxes. Various kinds of commercial copper, and a copper alloy containing upwards of 5 per cent. of nickel and iron, were tested in this way. The outstanding feature of the curves, the co-ordinates of which are temperature and the number of revolutions required to crack and break the specimens, is the large number of maxima and minima which the author interprets from his data. For copper he gives five maxima and five minima. The fact, however, that these do not by any means always correspond to observed points gave rise to considerable criticism in the discussion and to a variety of alternative interpretations. From the fact that annealing greatly reduces the maxima and minima the author concludes that work plays an important part in emphasising transformation points, and goes so far as to say that "except in the case of phase changes in alloys, mechanical tests are to be preferred to heating and cooling curves as a means of studying changes of state with temperature." Even if this claim is admitted, it limits the application of such methods to ductile alloys, but not unnaturally objections were voiced to a statement which has certainly not been proved.

Dr. Rosenhain, in his paper, entitled "Some Appliances for Metallographic Research," described an optical instrument for the levelling of metallographic specimens, a new method of taking thermal curves, and a plotting chronograph, the last-named having been devised with the help of the Cambridge Scientific Instrument Co. These appliances have been originated by Dr. Rosenhain at the National Physical Laboratory. Great interest was expressed in them, particularly in the design of furnace for taking thermal curves. In order to obtain as nearly as possible a constant rate of heating or cooling of the metallic specimen a tubular furnace is erected vertically in which a "regular temperature gradient is established and steadily maintained while the specimens whose heating and cooling curves are to be taken are moved at any desired rate from the cold to the hot end of the furnace or *vice versa*." Heating and cooling curves obtained in such a furnace and in conjunction with the plotting chronograph show that very satisfactory results have been obtained. The power consumption with the hot end at 1000° C. is a kilowatt. No figures for higher temperatures have been given, and it will be interesting to have those stated when they have been determined.

With regard to the plotting chronograph, the author's endeavour has been to originate an instrument which shall furnish an inverse rate curve "plotted to an adequately open scale." The apparatus is not as yet entirely self-recording, but represents a considerable step in this direction, and it gives the curve obtained with no other human intervention than the periodic tapping of a key.

The paper by Prof. Read and Mr. Greaves, of University College, Cardiff, contains an account of their investigations on nickel-aluminium and nickel-copper-aluminium alloys, more particularly the light alloys of the last-named group, and is a continuation of their earlier work on the heavy alloys of the same metals. They find that, as regards the ternary alloys, copper and nickel can replace each other without the resulting properties being affected, and, in fact, that certain characteristics of the alloys are determined by the total percentage of copper and nickel present. As they point out, this is intelligible in view of the fact that the two metals possess almost identical densities and very similar atomic volumes. Moreover, micrographic analysis shows that the internal structure of the alloy scarcely alters when the one metal replaces the other. Inasmuch as nickel costs about three times as much as copper, and its melting point is nearly 400° C. higher, it is clear that it cannot compete with it economically in the case of such alloys, except perhaps in a few instances where the need for resistance to corrosion in certain liquids is sufficiently imperative to outweigh considerations of expense.

A very useful compilation of etching reagents and their applications to metallography was presented by