becomes drier, and Eriophorum is replaced by a narrow band of Calluna moor. Peat is absent on the slope below, and the ground is tenanted by Nardus grass heath, yielding to a wetter type of grass heath dominated by Molinia and Eriophorum. Such a succession of terraces of Eriophorum bog, Calluna moor, Nardus grass heath, and Molinia-Eriophorum moor can be distinguished from a distance of many miles in the later months of the year, when the bleached Nardus stands out in vivid contrast to the sombre hued Calluna and Eriophorum associations.

The lower slopes of the alpine moorlands are generally covered by heather associations, which yield to pasture and grass heath as the summits are approached. The drier hills are covered by an association consisting of Calluna, *Rubus Chamaemorus, Vaccinium Myrtillus,* and *V. Vitis-Idaea*; the wetter hills are characterised by a much greater development of *Eriophorum vaginatum* and *E. angustifolium.*

The summits of the hills are generally tenanted by a few stunted members of the lower associations; in some cases, however, the vegetation only forms patches separated by bare stony soil or peat. Part of the summit plateau of Cross Fell at 2900 feet is entirely tenanted by *Racomitrium lanuginosum,* which forms low mounds of peat frequently broken by patches of stones and bare soil, a formation bearing a close resemblance to a moss-tundra of northern latitudes.

A considerable portion of the higher ground is covered with a deposit of peat varying in thickness from a few inches to nearly 20 feet. The peat appears to be undergoing rapid denudation at the present day—in many places large areas are quite unoccupied by vegetation, and exhibit the channelled and wasted appearance characteristic of peat-hags. These features can be seen on all the peat covered hills of the Pennines, the Cheviots, and the Scottish southern uplands, being particularly well marked on the Moorfoot Hills and in the Tweedsmuir district, and again appear in most of the peat districts of the Highlands. Many of the lowland mosses, particularly those bordering on the Solway Firth and along the west coast, exhibit no such denudation. How far the denudation of the mosses in the hill districts is due to drainage operations it is difficult to say, but the fact that the peat is generally wasted away quite as much on the more remote moorlands where artificial drainage has scarcely been carried on at all as on the drained areas lends strong support to the view that denudation is due to climatic changes. This is further supported by a detailed examination of the deeper peat beds, which frequently show many alternating beds of wet and dry condition plants. The peat beds on the Cross Fell chain are evidently of very ancient origin, as the author[1] has found the remains of an Arctic flora at the base consisting of Arctic willows, and the peat above contains the remains of extensive woodlands up to an altitude of 2700 feet. The area in which woodland remains in the peat have been observed is about 140 square miles, whilst only 11 square miles are forest clad at the present time.

Gunnar Andersson[2] has shown that the destruction of some of the woodlands buried in the peat of Sweden has been caused by artificial retention of drainage water and a gradual exhaustion of food supply in the upper layers of the peat, thus bringing about a gradual swing from woodland conditions to moss conditions, and again to heath conditions. These causes may have produced alternations of woodland, moss, and heath in some of our low-lying mosses, but an examination by the author of the peat lying between the woodland beds suggests that the destruction of much of the buried forest growth has been due, not to local alterations in drainage and failure of food supply, but to climatic changes acting over very long periods of time.

FRANCIS J. LEWIS.

THE ABNORMAL TIDES OF JANUARY 7.

AN abnormally high tide was experienced down the east coast of Britain on Saturday last, January 7, extensive areas being flooded and considerable destruction wrought. At 6 p.m. on Friday, January 6, as shown in the Meteorological Office reports, a very deep cyclonic system appeared over the upper part of the North Sea, the barometer at Sumburgh Head having fallen quickly to 28·7 inches. There was a steep gradient for north-westerly winds, and in the course of the night a more or less severe gale from that quarter was experienced over the North Sea, and as the south-going tide from the Pentland Firth was then on the flood, both its velocity and its volume were greatly increased, so that it reached the Thames estuary some hours ahead of its time, and was several feet above the calculated height. While the low barometer of Friday night may have caused the tide level in the far north to have been raised about a foot, the very rapid increase of pressure to 29·83 inches at 8 a.m. on Saturday at Sumburgh Head, a rise of 1·13 inches in fourteen hours, may have done something towards swelling the volume of the tide further south. Except for the hard gale, the conditions were very similar to those which prevailed with the great tide experienced on the southern and south-western coasts at the beginning of February, 1904 (NATURE, vol. lxix. p. 348).

Much damage was done all along the coast from Scarborough to the Thames. At the former place the pier was entirely washed away, and at Hull, Goole, Boston, Yarmouth and Lowestoft, and other places the low-lying parts of the towns were flooded. The damage was not due to unusual violence of the wind alone, but to the combined effects of wind and tidal waves. From the returns of the Meteorological Office it appears that the force of the gale from Wick to Yarmouth varied from 7 to 10 on the Beaufort scale. The tide was the third after the new moon, and laid down in the tide tables as less than a full spring tide. At Boston 28 feet 5 inches was recorded on the gauge at the dock, or 116·47 feet above Ordnance Datum, being 4 feet 8 inches above the height expected. The following tide in the evening was 21 feet 11 inches, or 1 foot 10 inches below the tide table height, the difference in the two tides being 6 feet 6 inches. The highest tide recorded there previously was in 1883, when the tide rose to 29 feet, the great record tide of 1810 rising to 29 feet 4 inches. Notwithstanding the great height to which the tide rose, it ceased flowing nearly half an hour before its proper time.

The tidal wave had fortunately somewhat expended its energy before reaching the Thames, but the water was in a very disturbed condition. By mid-day the water at Putney Bridge had risen as high as it should have been at full tide, which was not due until 3.45. At 1.30 it was a foot higher than any spring tide in recent years. Shortly after this the water began to recede, and continued to do so for half an hour. Then the water again rose, and at 3.15 the ebb again set in. The water in the Thames and Medway estuaries was kept from receding by the gale, and on the morning of Saturday it was 8 feet above its normal height. At 9 a.m., when the tide had still $4\frac{3}{4}$ hours to flow, it was running up the Medway 6 feet above the anticipated height at this stage. By 11 o'clock the level of high water was reached, but during the remaining $2\frac{3}{4}$ hours the flow was very slight compared with the earlier stages, and although the water rose from 2 to 3 feet above the normal height, there was no overflow or breaches in the banks.

THE ELECTRO-THERMIC MANUFACTURE OF IRON AND STEEL.[1]

THIS report is of great interest and importance to iron and steel metallurgists, and the appointment of the commission which has drawn it up suggests that Canada has an enterprise in fostering metallurgical knowledge which the Government of the mother country might well imitate for the advantage of British metallurgical industries. The English metallurgist attached to the commission was Mr. F. W. Harbord.

Three processes were experimentally examined:—(1) the Kjellin process at Gysinge, Sweden (this is an induction process not involving the use of electrodes); (2) the Héroult process at La Praz, France (this is a resistance method involving the use of electrodes); (3) the Keller process (also a resistance method in which electrodes are employed).

On p. 15 of the report Dr. Eugene Haanel, the chief

[1] British Association Reports, 1904, Section K.
[2] "Svenska Vaxtvarldens Historia." (Stockholm.)

[1] "Report of the Commission appointed by Mr. Clifford Sifton, Minister of the Interior, Ottawa, Canada, to Investigate the Different Electro-thermic Processes for the Smelting of Iron Ores and the Making of Steel in Europe." (Ottawa: Department of Interior.)

commissioner, remarks that he considers "By far the most important experiments witnessed by the Commission were those made by Keller, Leleux and Company at their works at Livet."

It is a little difficult to realise upon what grounds the above conclusion was arrived at. Putting aside the speculative calculations of M. Keller and descending to experimental facts, it appears that the commission saw smelted several tons of pig-iron, as a rule remarkably high in manganese (1·5 per cent. to 4 per cent.), and hence of limited commercial interest, and as it is evidently not thought by the commission that the electric furnace is to become a serious competitor with the blast furnace, the specified exceptional value of these results from an industrial point of view is not quite clear.

As regards steel, only one not very satisfactory and untested heat was made (see pp. 77–78), yet upon such evidence the report states that this process is capable of producing steel equal to the best products of Sheffield's crucibles. Such premature conclusions based on such scanty data are not calculated to carry conviction to the experienced metallurgical mind.

The commission also describes a series of experiments made by M. Héroult at La Praz works. The analyses of the steels obtained appear quite satisfactory, but this process is hardly capable of competing with the ordinary open-hearth furnace even from the rosy point of view taken by the commissioners based on costs calculated (in all good faith) by the patentee.

From a British point of view Kjellin's induction process deserves the most serious attention in view of (under certain conditions) its probable competition with the crucible steel process.

Analytically, mechanically, and micrographically this steel leaves nothing to be desired, but unfortunately chemical and tensile tests, and the indications of the microscope, have a limited value in determining the working capabilities of tool-steel.

In his "conclusions" on p. 115 of the report, Mr. Harbord states that "Steel, equal in all respects to the best Sheffield crucible steel, can be produced, either by the Kjellin or Héroult or Keller processes, at a cost considerably less than the cost of producing a high-class crucible steel."

The above statement, so sweeping and involving issues of profound industrial import, should have been made only as the result of a series of exhaustive working tests. For such, in the report, the reviewer has sought in vain.

It is true that a series of tests of turning tools made from Kjellin and Héroult steels has been carried out at Woolwich by Mr. H. F. Donaldson, but the results are quite inconclusive, because of the steels employed hardly one was fit for turning tools.

Cold sett steel, carbon 0·8, cold chisel steel, carbon 0·9, tap-steel, carbon 1·1, and drill steel, carbon 1·2, have all been set to do the work of a comparative turning tool steel of carbon 1·38 per cent.

The natural consequence is that in the Woolwich results, where "E" means equal to the ordinary Woolwich turning tool steel of carbon 1·38, and "NE" means not equal to that steel, we find in the report, pp. 87 and 88, five "equals" and no less than fourteen "not equals."

As to whether Kjellin electric steel is or is not equal to crucible steel time alone can show. The conclusion of the commission may be accurate, but it is certainly not based on any scientific evidence worthy of the name.

Such evidence on a commercial scale can be conclusively obtained only by at least two comparative years of shop practice, employing all kinds of tools, and recording the average wear and waste of the steels as evidenced by the ratio between the work turned out and the annual cost of the tool steels purchased.

In the micrographic section of the report the reviewer notes with regret a recrudescence of the use (in this connection) of the meaningless and unscientific term "grain" in describing the allotrimorphic crystals of ferrite.

These crystals, although usually lacking idiomorphic external faces, nevertheless present that internal molecular symmetry associated with individual crystals, and hence should be classed as such.

Prolonged tests on Kjellin steel of all carbons, compared with similar crucible steels, have been inaugurated at the University College of Sheffield, and the erection of a Kjellin furnace capable of making one ton of steel per day is under consideration.

Without in any way compromising one's industrial attitude as to the exact capabilities of the respective methods devised by Messrs. Héroult, Keller and Kjellin, one can cordially congratulate these gentlemen on the scientific ability displayed in the development of their several methods, all of which, within their legitimate spheres, are undoubtedly of great metallurgical value. It is the more necessary to say this because such value is liable to be discounted by the hasty and ill-digested conclusions drawn by the Canadian commission.

J. O. ARNOLD.

LONDON FOG INQUIRY, 1901–3.[1]

THE Meteorological Council have issued their final report on the above inquiry, which had to be terminated at the end of the winter 1902–3 as the London County Council were unable to make any further contribution to its cost beyond the 250*l.* originally assigned. A short account of the chief results obtained by Captain Carpenter from the observations of the winter 1901–2 has already appeared in these columns (vol. lxvii. p. 548). During the succeeding winter records of the duration and intensity of fog were continued at forty-six stations in and around London, and in addition to this the scope of the inquiry was extended to include a detailed study of the distribution of air temperature over the London area. With this object thermometer screens and dry bulb thermometers were issued to thirty fire brigade stations, and daily observations of the air temperature were made at fixed hours.

The material so accumulated has been utilised to determine so far as possible the physical causes most active in producing fog in each case. The guiding principles adopted in the classification are those suggested in an article by the secretary to the Meteorological Council which appeared in NATURE (vol. lxiv. p. 649) at the time when the inquiry was started. The majority of our fogs were found to be due to radiation from the earth's surface during calm nights. Others, among them the most persistent fog of the winter, were caused by the passage of warm air over a previously cooled surface, while a third group were identified as "cloud" fogs. A certain number of fogs could not be included in any of the above categories. They appeared to be mere accumulations of the products of combustion in an almost calm atmosphere, and as such were termed "smoke" fogs. Full particulars of the thirty-nine most serious fogs of the winter are given in an appendix.

Among the chief results of the inquiry must be reckoned the establishment of a workable scale for the estimation of fog intensity by different observers, based on the extent to which traffic is impeded by land, river, and sea.

Comparison of the fog statistics from the various stations confirms Captain Carpenter's results. With a few possible exceptions which need further investigation, there is no evidence to show that, in London, geological formation has any influence on liability to fog. Again, as was to be expected, the fog frequency on the river and in the parks is very high, but the evidence does not support the view that the fog there found drifts far into the neighbouring districts.

With regard to the main purpose of the inquiry, greater precision in fog forecasts, Mr. Lempfert points out that a first step would be the establishment of a night service at the Meteorological Office. As the majority of fogs are caused by nocturnal radiation, and the intensity of this radiation depends largely on the accident whether the sky is free from cloud or not, it is manifest that forecasts issued at the suggested hour of 5 a.m. would have a much greater chance of proving correct than the present ones, which are based on observations taken at 6 p.m. on the previous evening. As most fogs become thick soon after sunrise, several hours' warning could still be given, though the hour would

[1] Report of the Meteorological Council upon an Inquiry into the Occurrence and Distribution of Fogs in the London Area, during the Winters of 1901–2 and 1902–3, with Reference to Forecasts of the Incidence and Duration of Fogs in Special Localities, to which is appended the Report by R. G. K. Lempfert, M.A. on the Observations of the Winter 1902–3.