tests, must be regarded as established by the work of Charpy, Bengough and Hudson, Mathewson and Phillips and Thompson. Moreover, according to Howe, the first effect of slight heating in the case of iron may be either a softening or a hardening, depending on the intensity of the previous deformation, and in his view at least two agencies are at work in producing these results.

Prof. Carpenter and Mr. Taverner, of the Royal School of Mines, have investigated the way in which the tenacity of cold-worked aluminium of one particular degree of hardness is affected after the application of heat at various temperatures, and for periods of time very much longer than any that have been employed in any previous investigations. They find that the effect of heat at temperatures from 550°–300° C. inclusive is to cause a very rapid softening of the metal, and that *the same ultimate value of tenacity is reached in all cases.* Softening is complete in ninety-six hours, and nearly the whole of this occurs in the first hour of the test. At 250° C. the rate of softening, while still considerable, is much less rapid. Between 600 and 800 hours are required for complete softening, and here also the same ultimate value of tenacity is reached as at higher temperatures. From 200° to 100° C. inclusive the rate of softening is slow, and as the temperature of 100° is approached, very slow. The actual sequence of changes can be classified conveniently under three heads:—(1) A comparatively rapid drop in tenacity in the first hour. (2) A tendency either to cease falling or actually to rise, such rise, in one case only, bringing the tenacity up to the original value. This period is in most cases completed in about 100 hours. (3) A relatively very slow fall of tenacity which is maintained on the whole steadily. These tests are still in progress. Assuming the present rate of loss of work-hardness to be maintained, and that the metal ultimately reaches the same tenacity as specimens tested at the higher temperatures, periods of the order of from one to three years will be required for completion. The fluctuations in the tenacity values referred to under (2) appear to be well established. Similar fluctuations in the rate of solution of hard-worked aluminium-sheet had previously been recorded by Seligman and Williams. The authors have also shown that the cold-rolled aluminium loses a considerable part of its work-hardness, in the temperature range 200° to 100° C., with scarcely any recovery of plasticity as judged by the elongation test.

H. C. H. C.

BRILLIANT FIREBALL OF OCTOBER 1.

METEORS of the largest type exhibit a propensity to appear in the twilight of early evening. On Monday, October 1, at 6.37 p.m., a splendid object of this class presented itself, moving slowly along an extended flight in a south to north direction. It was observed by a large number of persons in various parts of the country, and descriptions have been received from places so wide apart as Weston-super-Mare, Somerset, and the extreme North of England.

The accounts to hand are not, as usual in such cases, in perfect agreement, but some of them are excellent, and form a good basis for determining the meteor's real path in the air. The Rev. Canon J. M. Wilson observed the meteor from Worcester, and describes its flight as from 40° E. of N., alt. 15° to 18°, to 5° E. of N., and alt. 5°. Duration about $2\frac{1}{2}$ sec. for the section of path he viewed. The Rev. J. Dunn, of Weston-super-Mare, describes the fireball as very brilliant, passing just above Capella. It was visible for five seconds; the head was some ten minutes of arc in diameter, and it threw off a short, reddish trail of sparks. Mr. H. J. Woodall saw the fireball from Oldham, and says it was in a direction 9° N. of E., and falling towards N. at an angle of 30°. The Rev. Watson Stratton, writing from Goole, Yorks, gives the path as from N.N.E., nearly as high as Polaris, to a point a few degrees W. of N., and about alt. 12°. Mr. Philip Burtt was at Penrith Station, and viewed the meteor as it descended and terminated its career just to the right of the moon. It was of a rich yellow colour. Mr. T. J. Moore reports from Doncaster that the direction was from E.N.E. to N.N.W., and that about one minute after the object had passed a very loud explosion was heard.

Many other accounts from Liverpool, Grantham (Notts), and other places might be quoted. Spectators agree as to the remarkable brilliancy of the object, and state that it aroused apprehension in cases where its real nature was not understood.

I have computed the real path as follows:—

Height at appearance, 56 miles over 4 miles E. of Boston, Lincolnshire.

Height at disappearance, 19 miles over 15 miles N. of Stanhope, Durham.

Length of luminous course, 160 miles.

Velocity per second, 23 miles.

Radiant point, 320° − 22° in Capricornus.

The Rev. J. Dunn's estimate of the diameter would give the dimensions as half a mile, but this included the flaming effect and glare. Probably the solid nucleus was not many inches in diameter. As to the sound heard at Doncaster, it came too quickly for it to have been a meteoric effect.

Another fireball was seen on September 23. It lit up the sky, and was directed from a radiant at about 322° − 23°, and probably belonged to the same system as the more recent one of October 1. Observations of the latter are still coming in, and it may be found desirable slightly to alter the results above given. A second fireball was seen on the same night at 10.46. Its radiant appears to have been at 351° + 2°, and its height seventy-six to forty-one miles.

W. F. DENNING.

THE TASK OF BRITISH AGRICULTURE.

THE speech of the President of the Board of Agriculture at Darlington on October 5 calls for the widest attention as an authoritative pronouncement on the present situation of British agriculture in relation to the need for increased food production. The exigencies of a long war have imposed upon the British farmer the duty, on one hand, of securing a greatly increased production of bread-corn and potatoes, and, on the other, of maintaining the supplies of milk and meat. The ideal placed before him by the Board of Agriculture in the first place is an increase of 3,000,000 acres under grain, potatoes, and roots, to be obtained partly from existing arable land and partly by ploughing up pasture. To secure this end the Government is prepared to help, and Mr. Prothero outlined how much has already been done in the way of guaranteed prices for corn, extension of credit facilities, supply of soldier and women labour, increased supplies and controlled prices of fertilisers, supply of horses, ploughs, and ploughmen, and further of mechanical tractors. Of the last-named 1500 are already at work, and it is hoped that by February next the number will have increased more than fourfold. A timely warning was given, however, that the tractor in its present stage of development must be regarded as the least efficient of ploughing implements, and should be used preferably for the lightest work.

On the question of the maintenance of the milk supply Mr. Prothero urged that with the reasonable scale of prices fixed for milk and the efforts being made to secure reduced prices for feeding-stuffs and a preferential call upon supplies, the dairy farmer was being fairly treated, and should endeavour to surmount his difficulties by securing greater economy in the use of food and an increased average milk output per cow.

On the subject of beef production Mr. Prothero did not conceal his apprehension that the scale of prices fixed by the Food Controller for the winter would not only gravely imperil our meat supplies, but would even operate adversely against corn production. From his practical experience he was convinced that current prices left little margin of profit, if any, for the arable farmer, who feeds and fattens cattle for the winter market. A price of 60*s.* per cwt. live weight for stall-fed cattle puts a premium on grass as the cheapest form of cattle-feeding, and thus renders the farmer more reluctant than ever to plough up grass; it penalises stall-feeding on arable farms, and so tends to diminish the supply of manure for the needed corn crops. We are glad to see, therefore, the announcement in Wednesday's *Times* that the War Cabinet has conceded the appeal of the farmers for a revision of the scale of maximum prices fixed some months ago for home-killed beef for the Army. Under the sliding-scale of prices for live cattle, as originally announced, the price for home-killed beef fell from 74*s.* per live cwt. in September to 72*s.* in October, 67*s.* in November and December, and 60*s.* from January 1, 1918. It has now been decided that the November and December price of 67*s.* shall continue until July 1, 1918, and that the 60*s.* maximum shall then come into force for the rest of the year.

At the best, with the reduced supplies of feeding-stuffs, it will be difficult to avoid a serious shortage of meat in May and June next year. We must not be driven to slaughter more cows or veal calves; we cannot depend upon an increased import of meat; the only safeguard within our control is a reduction in our consumption of meat, and this must be pressed for more and more insistently. The eloquent appeal to farmers in the closing part of Mr. Prothero's speech will assuredly not fall on deaf ears, but it is equally necessary that the public shall realise their difficulties and extend to them the sympathy which no section of the community more rightly deserves.

CHEMICAL LABORATORY PORCELAIN.[1]

THE first attempts to make porcelain in Europe were undoubtedly in imitation of the Chinese porcelain imported into Europe by the Dutch, English, and French East India Companies about 1673.

Its beautiful whiteness, its thinness, its translucency, its close vitreous fracture, apart from, and also in conjunction with, its decoration, at once appealed to and obtained the admiration and emulation of the Europeans.

The story of the struggle in the attempt to reproduce it is not within the scope of this paper, but suffice it to say that it was accomplished in Germany by Bottcher about 1706–18, and in England by Cookworthy, of Plymouth, about 1767.

The one factory continued for the reason that not only were the products excellent, but the financial success was not the main object, while the other had to bear its own losses, and though there was considerable promise of success, the financial aspect of the undertaking was a complete failure. It is well, then, at the outset to note that we do not owe the origin of the porcelain to the Continental potters, but to the Chinese. Chinese porcelain being at that time the only translucent pottery in existence, there can be no wonder about the admiration it called forth.

It cannot be surprising, then, that the English potters were very anxious to produce such a body, and if that object could be attained, the means by which it was achieved were secondary matters, and we find that instead of continuing the manufacture of hard-paste porcelain, they produced, about the end of the eighteenth century, (1) a beautiful white earthenware which for generations secured the market of the world, and made it possible to replace almost all other pottery for domestic purposes; (2) a translucent white porcelain similar to the Chinese, by the use of other materials and methods, equally beautiful, which for more than a century has held its own amongst all other porcelain productions, and is generally known as bone china.

The ceramic productions of the world as regards their bodies or paste, apart altogether from decorative effects, vary from goods made from the coarsest to the finest clays, through almost every variety of texture, by admixture of the natural clay with other materials, such as sand, flint, barytes, felspathic rock, etc. From these materials were produced at one end of the scale the cinerary urns of our great ancestors, and, at the other end, the excellent hard-paste porcelain which we are considering to-day.

The marvellous difference in the productions of the various peoples of the world may probably be explained by the general assertion that the potters have from the very earliest times worked with the materials they had at hand. The cinerary urns of the ancient Britons were made from natural clays.

The Staffordshire potters used, at first, natural clays, found cropping up simultaneously with the coal, and afterwards improved the colour and texture of the product by the addition of, first, fireclay, then Devon and Cornish clay, and calcined flint. Messrs. Eler Bros. used the red marl of the Burslem district for their fine red ware. Bottcher, of Germany, at first made red ware from local clays, etc., and afterwards porcelain from the white clays or kaolin, and pegmatite.

The Chinese for centuries had been working with their natural materials, kaolin and petuntze, and from these produced their fine porcelain. Some of these various clays naturally required a much greater heat than others to produce hard vitreous bodies.

These varying conditions with regard to materials to the hand of the potter, when means of communication were so restricted, necessarily involved very varied methods of manufacture. The materials differing so essentially from each other naturally required very varying degrees of heat necessary to bring to maturity.

The kaolin and petuntze used by the Chinese would require a much higher temperature to mature than the clays, etc., used in other countries at the time. The exact temperature would not be found at once, and in working out the same an observant potter could not fail to notice the changes taking place in the fired material in regard to vitrification, translucency, and finally distortion at the various temperatures. Thus in all probability, without any more scientific knowledge whatever than careful observation, the fine product of that time would be produced which even now (centuries later) is the object of our research.

While the Chinese were for centuries making the most suitable material in the world for chemical laboratory ware, they had no use for such, and consequently did not make it. It was only with the advance of scientific chemical knowledge in Europe that the need was felt for the various porcelain accessories that were then called into use.

It is not surprising, therefore, that Germany and France, having continued making the Chinese type of

[1] Abridged from a paper read at the annual meeting of the Society of Chemical Industry, July 18–20, by Mr. Henry Watkin.