Viscosity of Cobbler's Wax.

FOR slowly damping a vibrating instrument of importance to the Navy, I let a metal knife cut through cobbler's wax, which is just soft enough to be squeezable between the fingers. The actual softness or hardness of the wax does not greatly matter, but what does matter is its becoming very much softer when its temperature increases from 15° C. to 30° C. This is its defect. I write in the hope that some one of your readers may be able to tell me of a suitable substance which will vary less in its softness as its temperature changes.

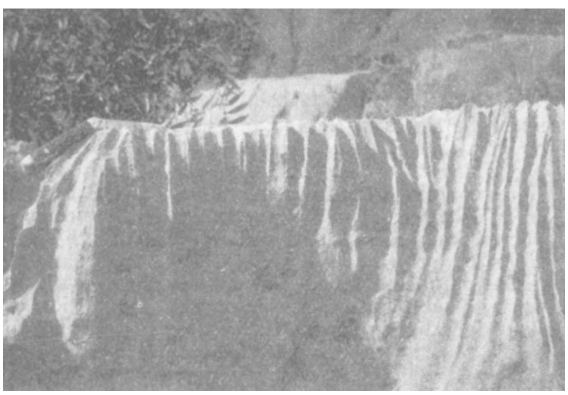
JOHN PERRY.

25 Stanley Crescent, Notting Hill, W., December 9.

The Cause of Fluted Weathering.

HAS the cause of fluted weathering, I would like to ask, ever been determined? It differs widely from all other forms of weathering that I have seen or read of. The long, smooth, parallel grooves are met with sometimes on the two sides of a block of limestone when such lies so that there are roof-like surfaces uppermost. On these two sides they frequently correspond at the ridge and follow a direct course downwards unless compelled to curve round some projecting boss.

The grooves may be 3 ft. long and of about equal



Fluted weathering in limestone, Italy. ×⅛.

width and depth along their whole course. The only specimen known to me in English museums is in the Oxford University Museum, which was got by Prof. W. J. Sollas from the Gemmi pass. I have seen good examples in the Jurassic limestone of Liguria, especially on the west of Finalmarina. Behind Pietra, on the left of the footpath to Ranza, the block, shown in this illustration, with several others, were seen. They were under olive trees, but it seemed impossible for such fluting to be produced by drip, and I wonder whether it could be the result of heavy dews or to some zoning influence.

G. ABBOTT.

2 Rusthall Park, Tunbridge Wells, December 4.

Winter Thunderstorms.

THOSE of your readers who may observe thunderstorms in the British Isles during the winter months would give great assistance to an investigation of thunderstorms on which I am engaged if they would report by postcard when they observe lightning or thunder during this winter. When sheet lightning is observed at night the time and direction should be given, and a note as to whether many flashes were seen or whether there were only two or three. When thunder is heard the time should be given, and the direction of the storm; it should also be stated whether lightning was seen and whether rain occurred. Much useful information might be gained from winter storms, but as thunderstorms may be very local they may sometimes be missed by the official observers; I should therefore gladly welcome help from anyone who is good enough to send me information. It is obvious that only winter storms can be dealt with in this way; I would therefore ask those who are willing to help to send information up to March 31st only.

CHARLES J. P. CAVE.

Meteorological Office, South Farnborough, Hants, December 9.

The Quadrantid Meteors.

THE ensuing display of these meteors occurs in the absence of moonlight. If the maximum continues to be at about the same position of the earth's orbit as formerly it will be in the early evening of January 3, which would be a convenient time for observation, although the radiant point is comparatively low then, the morning displays being the best.

T. W. BACKHOUSE.

West Hendon House, Sunderland, December 6.

LABORATORY ELECTRIC FURNACES.

MANY of the modern methods of chemical analysis involve the use of furnaces for the prolonged heating of materials; for example, the determination of carbon in steel, the carrying out of sealed-tube operations, etc., may be cited. Until recently, gas furnaces have almost exclusively been used for such purposes, but it seems probable that these will be largely replaced, in the future, by the improved types of electric furnace which are now obtainable. The electric furnace offers many advantages over the gas furnace, particularly in cases where it is desirable to maintain a constant temperature for any length of time.

The introduction of the comparatively new high resistance alloys of small temperature-coefficient has greatly simplified the construction and working of wire-wound furnaces. Such a furnace consists in its essential details of a tube of refractory material such as fireclay, alundum, or silica, upon which is wound a suitable length of the wire or strip; the tube is then supported in a case, the intervening space being filled with a material of low thermal conductivity, magnesia, for example. To ensure a long life and satisfactory running, attention must be paid to certain constructional details. The principal of these are:—(1) That the wire employed is as thick as possible, consistent with the dimensions of the tube and the voltage of the supply on which it is intended to be used; (2) that the wire is effectively protected from oxidation by preventing the access of air, the winding being for this purpose surrounded by a layer of powdered quartz or other suitable material; and (3) that the furnace is designed for and worked at the lowest voltage convenient.

In deciding upon the amount of lagging necessary, the purpose for which the furnace is to be employed must be considered. The provision of thick and efficient lagging makes the furnace economical in that a comparatively small amount of energy is required to maintain it at any definite temperature; it, however, renders the furnace very sluggish, and for some operations this is a disadvantage. The ability to change the temperature rapidly and to adjust the new temperature quickly to a definite and constant value is a factor which frequently outweighs any small advantage accruing from a low power consumption.

We may consider for a moment the question of the power consumption of an electric furnace. A reasonably well-lagged furnace, with a tube, say, 1 in. internal diameter and 24 in. long, heated to the full temperature of 1000° C. over the central 18 to 20 in. of its length, should consume power at the rate of about 400 to 500 watts. This refers to the furnace itself, and it must be borne in mind that there is always an unavoidable amount of energy lost in the regulating resistance used in series with the electric furnace. This will

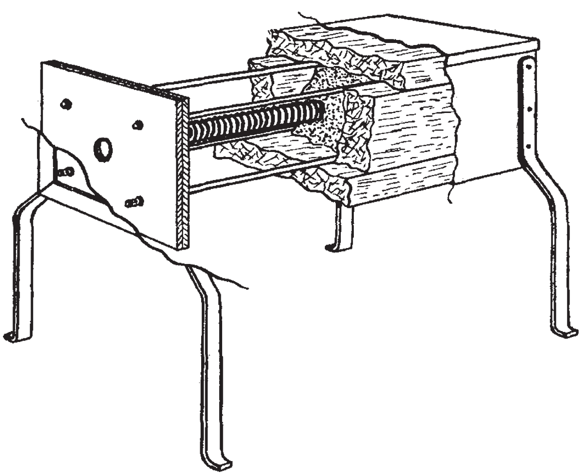


FIG. 1.—Sectional diagram of Messrs. Gallenkamp's furnace.

frequently amount to more than 50 per cent. of that usefully consumed in the furnace, and the loss cannot be overcome if provision is to be made for a fairly wide range of furnace temperatures. The external loss may be reduced for furnaces always run at a definite temperature; as in this case the winding may be so chosen to require only a small external resistance or even to dispense with it altogether. The latter procedure is not generally to be recommended owing to the lack of control thereby introduced.

If it be desired to maintain the temperature of a furnace constant to within about 20° C., it will often be found that the voltage of the commercial power circuit is not sufficiently steady for the purpose. A fluctuation of 5 per cent. in the voltage is not unusual, and the energy, and consequently the temperature, changes are thus of the order of 10 per cent. Rapid variations above and below a mean value are not of great importance, as the effect of these is damped out by the lag of the furnace. The intermittent use of large motors, etc., on the same energy distribution system is, however, a frequent source of trouble. The most accurate temperature control can be obtained by running the furnace off a large capacity storage battery.

To assist in the control of an electric furnace, it is always desirable to include an ammeter in the supply circuit. For a furnace wound with a low temperature-coefficient alloy, such as "nichrome," the current readings alone form a useful indication to the behaviour of the furnace, as the resistance does not change to any very great extent. In the case, however, of a platinum or nickel wound furnace this is not sufficient, and the volt-drop across the furnace must also be measured. It will frequently be found that changes in the regulating resistance in series with a platinum furnace produce no marked changes in the current, the volt-drop on the furnace, however, being considerably affected. The use of a wattmeter is hence to be recommended for furnaces wound with materials the temperature-coefficient of resistance of which is high.

In the construction of some furnaces use is made of various fireclay cements to hold the winding in position on the tube. Except for furnaces which are not intended to run above 900° or 1000° C. this is undesirable, and a more satisfactory plan is to employ a tube on the external surface of which a spiral groove is moulded; such tubes may now be obtained in a variety of sizes from the leading makers of refractory materials. The ends of the winding should be held firmly in position by being bound with a few extra turns of the same material. At each end of the tube these wires, when tightly twisted together, will form multiple stranded leads serving for the current supply. The use of a different metal in contact with the winding is generally unsatisfactory, and the failure of a high temperature furnace is often due to this fault in construction. Another cause of failure which may be overlooked is the presence of a small piece of foreign matter or impurity in the lagging employed. If this comes into contact with the hot winding, it sometimes leads to fluxing of the wire and consequent breakdown of the furnace. The material used for lagging should hence be carefully examined, and, needless to say, it must be of such a nature that it will not react chemically

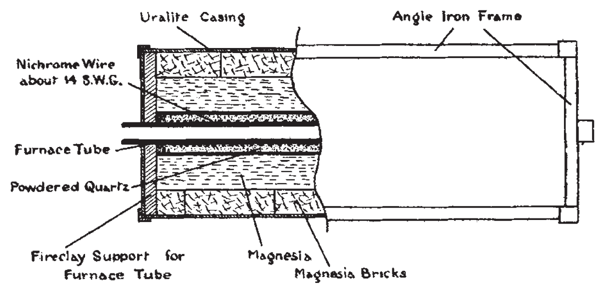


FIG. 2.—Diagrammatic representation of a typical wire-wound electric furnace.

with the winding, even after long exposure at high temperature.

Some electric furnaces, embodying many of the points above referred to, have recently been put on the market by Messrs. A. Gallenkamp and Co., Ltd., London, and in the several designs available the needs of the chemist have been fully considered. The construction of a single-tube furnace is shown in Fig. 1. The lagging is provided by four slabs of a mixture of magnesia and asbestos, while the central space surrounding the wound tube is filled with powdered quartz. Electric furnaces for research work, and particularly for use at high temperatures up to 2500° C., may be obtained from Mr. Chas. W. Cook, of Manchester. He also lists a simple type of wire-wound combustion furnace for fixing on an ordinary retort stand. A similar furnace is supplied by Messrs. Baird and Tatlock, London, and should prove useful for many chemical operations.

OILS AND FATS.

CHEMICAL industry in Britain is now passing through a very critical period; many people are realising its importance, and it is being compared, not always to its advantage, with the German chemical industry. Whilst it is true that as regards the manufacture of dyes and pharmaceutical chemicals we have much leeway to make up, the same cannot be affirmed of all branches, even of the organic chemical industry. It is desired here to indicate briefly the present position of the oil and fat industry in relation to the application of science in it.

One illustration of the backwardness of applied chemistry in Britain which is often quoted by the would-be reformer is the lack of adequate text-books in English. In the great industry of oils and fats this reproach is certainly not justified; indeed, in Lewkowitsch's work[1] the industry possesses a text-book which is second to none, and has been translated more than once. Moreover, a challenge can be issued on behalf of this industry as one in which British foresight and enterprise have led the world. Whilst this success is in part due to the financial genius and organising ability of the founders of our great concerns, it is none the less principally based on the application of science, and probably in no other British industry has chemistry had such scope as in that connected with fats and oils. There is, perhaps, no better illustration of the chasm between the college and the factory, the existence of which was deplored by Dr. Forster at the annual meeting of the Society of Chemical Industry. The college has no idea of the knowledge of fats and oils possessed by the industry; writing with inside knowledge, this may be declared to be at least a decade ahead of the published literature. The colleges know not even the names of their industrial colleagues, or at least, like the proverbial prophets, these are without honour in chemical circles at home.

The third volume of Dr. Lewkowitsch's classic work gives a very complete summary of the technology of manufactured oils and fats, and even the most eminent expert will be certain to learn from almost any of its chapters. Unfortunately but a tithe of the knowledge which the writer really possessed of the actual working of the industry is recorded in its pages, doubtless because much of it had been acquired in confidence. As a consequence this, like other similar works, gives but an imperfect idea of the actual stage of development to which the industry has attained, and is to that extent disappointing when the manufacturer of to-day turns to it to help him out of his difficulties. All will agree, however, that Lewkowitsch's book is an integral part of the oil and fat industry, which his whole-hearted zeal and hard work did so much to advance, and that his all too early decease was a great misfortune.

The raw materials of the fat and oil industry are strikingly varied. At first limited in number, their scarcity and the consequent increase in value as the demand for soap and margarine grew have prompted a world-wide search to increase them, and chemical science has played an essential *rôle* in their development. Thus in early days soap was made in small works from tallow of local origin. As the works grew larger, tallow was imported to Europe from the large cattle and sheep raising districts in the New World. At the same time vegetable oils from the tropical countries began to be used for soap-making, and since the margarine industry also has learnt how to utilise such vegetable fats, the whole world has been laid under contribution to supply them. As most are the products of trees, their cultivation on any scale has not yet been successful, the exceptions being the oils from linseed, which is grown in temperate climates, and the soy bean of the East. Linseed oil is too unsaturated either for use in margarine or soap, but as a drying oil it has no equal. Until the discovery of the hardening process for saturating fats, the highly unsaturated whale oil and fish oils were of very limited application.

The manufacture of soap, an operation of great antiquity, is based on the simplest of chemical reactions, and even to-day in some countries it is carried out in a most primitive manner. This is in striking contrast to the up-to-date methods of the great British soap manufacturers, who have learnt how to make their soaps neutral so as to be without action on the skin or the most delicate fabrics; how to blend the fats which compose them so as to make soaps having any desired qualities; and even how to make the fullest use of the advance of physical chemistry, including such apparently academic branches as the phase rule.

Soap primarily requires a hard fat for its raw material; and with the margarine industry making the same request, the demand outstripped the supply. The situation might have become serious

[1] "Chemical Technology and Analysis of Oils, Fats, and Waxes." By Dr. J. Lewkowitsch. Edited by P. H. Warburton. Fifth edition. Vol. iii. Pp. viii+483. (London: Macmillan and Co., Ltd., 1915.) Price 20s. net.