A Radium Experiment.

It is usual to demonstrate the ionising property of radium by discharging an electroscope. The reverse experiment of charging an electroscope, or Leyden jar, is more effective, and can be made to ring a bell.

If a wire, about 6 inches in length, is coated with a salt of radium and placed in contact with the knob of an electroscope, the latter will quickly become charged if any charged body is placed within 2 or 3 feet. A small Wimshurst machine is very convenient for the demonstration, as it can be easily turned about to reverse the charge, or placed equatorially, when no effect is produced.

It is a good plan to arrange the leaf of the electroscope to discharge itself automatically to earth at a divergence of about 45 degrees; then the charging is repeated so long as a charged body is in the vicinity. Instead of sending the discharge to earth it may pass into a coherer, and so ring a bell or give a record.

When an induction coil is used it is easy to show that the prepared electroscope will keep on receiving a charge for some minutes after the coil is stopped; for instance, after working an 18-inch coil for one minute, some charge was given to a delicate radium-tipped electroscope when brought into the room four minutes later.

This duration of charge on air can be distinctly shown by filling a large paper bag with charged air and rapidly conveying the same to a Wilson electroscope in another room.

This is obviously due to a residual charge in the air, which persists long after re-combination of mixed ions. This arrangement of a radio-active body near, or, better, in actual contact with, a delicate electroscope is a very sensitive detector. The effect is not quite so good if the radio-active coated wire is placed in contact with the charged body, leaving the electroscope free. Upon exploring the charged air of a room, it is usually found to be divided into two areas of opposite charge; these can be mixed by waving an umbrella, so yielding a neutral mixture.

The fact that a charge is so easily acquired by an electroscope must be taken into consideration during delicate testing, for the mere act of withdrawing a vulcanite pen from the pocket will give a negative charge to a distant electroscope in ionised air.

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SUBSTITUTES FOR RUBBER.

THE present demand for india-rubber naturally directs attention to those articles which, to a greater or less degree, may serve to replace rubber in its industrial applications, and so help in conserving the supply.

Of such articles a very large number have been proposed. Those in actual use to any considerable extent are, however, relatively few. For present purposes the various surrogates may be distinguished as (1) rubber-substitutes proper, consisting wholly of ingredients other than rubber; (2) composite or "artificial" rubbers, which contain a certain proportion of natural rubber worked up with other substances; and (3) true synthetic rubber, namely, a product containing the rubber molecule synthesised in the laboratory or factory by chemical means from simpler compounds.

At present the first of these classes is commercially the most important. Scores of recipes are in existence, including very diverse ingredients; but the basis of most is a modified oil. At first sight there seems little suggestion of india-rubber in the properties of an ordinary vegetable oil, but a simple experiment will indicate the kind of modification which certain oils readily undergo, and which help to fit them for use as rubber substitutes. If we test the drying properties of boiled linseed oil by spreading a little of it over a slip of glass and allowing it to dry, a film of oxidised oil is eventually obtained, having a certain

modicum of toughness and elasticity. The liquid oil has taken up oxygen, and thereby become converted into a more or less elastic solid. Tung-oil substitute is essentially such an oxidised product, manufactured by heating the raw oil until it has absorbed enough oxygen to cause it to thicken and become solid on cooling, when it is powdered and worked up with a little petroleum.

In a somewhat similar way the oils can be made to take up sulphur, becoming thereby solid, and endowed in some degree with elastic properties. The treatment is analogous to the "vulcanisation" of rubber. "Brown" or "black" substitutes are manufactured by heating the oil with sulphur, a process corresponding to the "hot cure" method of vulcanisation. "White" substitutes may be made by merely mixing the oil, cold, with 20 to 40 per cent. of sulphur chloride; or, better, by first dissolving the oil in a suitable solvent such as carbon tetrachloride. This resembles the "cold cure" process used in vulcanising rubber. Colza oil is largely used for these purposes, but various others are available—linseed, maize, arachis, and castor oils, for example. The chemical reaction involved is a somewhat complicated one, but probably it consists mainly in the formation of what chemists term an "addition-product." The proportion of sulphur taken up by the substitutes varies rather widely, ranging from 5 to upwards of 15 per cent. As would be expected, oils which have previously been oxidised to a notable extent (e.g. "blown" oils) require less sulphur to saturate them than do the natural oils.

"Nitrated" oils are also used as the basis of some rubber surrogates. Thus one well-known product is a solution of a nitro-cellulose in linseed or castor oil which has been nitrated by treatment with a mixture of nitric and sulphuric acids. Other such articles are made by oxidising the nitrated oil with lead peroxide, or by simply heating it in air.

These oxidised, sulphured, and nitrated oils, in one form or another, are largely used as substitutes for rubber. Of the other substitutes proposed, a few examples may be given, to indicate something of their general nature.

First there are those which, while still retaining oil as one ingredient, include also other important constituents. Thus, "Fenton's rubber" is a mixture of oils with tar, pitch, and creosote; which mixture, when digested with nitric acid, gives a toughened mass, and this on heating yields an elastic product simulating rubber. "Russian" substitute, said to be useful for covering telegraph cables, contains as ingredients wood-tar, hemp and linseed oils, ozokerite, spermaceti, and sulphur. "Oxolin" is made by impregnating fibrous material such as jute or hemp with linseed oil, oxidising the oily mass with warm air, and working the product up between rollers into a coherent mass, which can then be vulcanised by heating it with sulphur.

In another category of substitutes oil plays only a subordinate part, or is altogether dispensed with. Thus "Jones's substitute" is stated to be made from various gums and gum-like products as the chief constituents. In W. H. Perkin's patent (23,031/07), gelatine or glue is dissolved in creosote and then treated with some reagent—potassium bichromate, formaldehyde, or tannic acid—which will render the gelatine or glue insoluble; after "setting," the mass obtained is digested with acetone to make it firmer. "Textiloid" has for its ingredients various resins, nitrocellulose, and camphor. As a curiosity in this class may be mentioned "grape rubber," produced from the skins of grapes by means of pressure; it is not, however, a commercial article. Finally, though this can only be