THE ARTHUR D. LITTLE RESEARCH INSTITUTE

IN the annual report for 1963 of the Arthur D. Little Research Institute, Dr. F. N. Woodward, the director, reviews some of the outstanding developments in the first seven years operation of the Institute *. These include the work on interaction between certain metals and water at very high temperature, hydrogen embrittlement investigations, which appear to be revealing at least one pickling method which could safely be applied to very strong steels after heat treatment, and tempering without causing hydrogen embrittlement.

Fundamental investigations of the release of corrosive vapours from wood under tropical conditions have given a technique which appears to be capable of reducing significantly the corrosiveness of kiln-dried woods. Observations on the chemical modification of cotton have given a technique for increasing crease-resistance, and work on the chemistry of ethylene sulphide has also yielded patentable techniques and products. Two basic investigations of potential long-term significance are concerned with the crystallization and properties of high polymers and with gaining an understanding of photoconductivity in organic compounds generally and polymers in particular.

In the Biochemistry and Biophysics Division, wheat proteins and anti-tubercular factors in milk whey received considerable attention, while the work on peat isolates of industrial value was expanded and preliminary work on the fractionation of inorganic polyphosphates carried out. In carbohydrate chemistry, several promising new polymers were prepared from glucose and its derivatives and the principle of co-polymerizing small amounts of carbohydrate with cheap, readily-available monomers, to give reactive co-polymers, has been demonstrated. These afford an easy route for introducing reactive groups to improve the dyeing properties and hydrophilic groups to improve the water-adsorptive power of conventional man-made fibres. The investigation of the emission of corrosive vapours from wood continued for a third year and methods for the analysis, by gas liquid chromatography, of the volatile acids and neutral compounds of wood have been worked out and applied to the assay vapours arising from the exposure of wood-shavings to high humidity and tropical temperatures.

In sulphur chemistry, white crystalline polymers have been prepared from ethylene sulphide; mercaptans have been found to react with ethylene sulphide to give products which are also mercaptans and which further react with ethylene sulphide. In physical-organic chemistry, an extensive search has been made for high-temperature-resistant materials in organic, organo-metallic and inorganic chemistry, while the physical chemistry section has been mainly concerned with the crystallization and properties of polymeric materials.

Recently, facilities have been developed for investigating the electrical properties of materials. In metallurgy, the reaction between metals and water vapour up to 1,500° C and above has been further investigated for aluminium and aluminium–uranium alloys and zircaloy-2. The investigation of the adhesion between molten glass and metals has been continued in order to improve understanding of the fundamental principles governing sticking between hot glasses and a metal mould while the glass is being blown to shape during manufacture of glassware.

* Arthur D. Little Research Institute. Annual Report for 1963. Pp. 48. (Inveresk, Midlothian: Arthur D. Little Research Institute, 1964.)

LUMINESCENCE OF ENSTATITE ACHONDRITE METEORITES

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WE recently reported the red luminescence of three meteorites of the enstatite achondrite type under proton excitation[1], and are now able to give some further information, including revised estimates of the radiant efficiency.

Our published spectrum for each meteorite shows a weak blue peak at about 4000 Å and a strong red peak at about 6700 Å (for example, Fig. 1), but with different red/blue peak intensity ratios for the three meteorites; we afterwards found that the differences were just as great between different samples of the same meteorite as between the three different ones. This suggested that two separate constituents of an inhomogeneous mixture were giving the red and blue luminescence, respectively. We then concentrated mainly on the Bustee meteorite, and a crushed sample was separated, by visual appearance under a microscope, into its main constituents. These were identified as follows: white enstatite ($MgSiO_3$), the main constituent; diopside ($CaMgSi_2O_6$), present as grey grains showing exsolution lamellæ of enstatite; brown crystalline oldhamite (CaS); and finally osbornite (TiN), present as a few minute golden octahedral crystals †. The latter two minerals are only known in meteorites, and do not occur in terrestrial rocks. These observed minerals agree with the known constituents of this meteorite[2]. We then investigated the luminescence behaviour of each constituent separately, under proton excitation. The enstatite part was found to give a spectrum like that already found for samples of the mixture. The diopside luminesced weakly, if at all—it was difficult to free it from enstatite, and the resulting spectrum was a weak version of the enstatite one, with no additional features. It was, therefore, probably just the spectrum of the enstatite contamination. The oldhamite constituent, which was only present in small quantities, also showed the spectrum of residual enstatite, but with an additional yellow peak at about 5800 Å. This peak is not usually evident in the spectrum of the mixture, probably because of the small amount of this substance present. Also, this constituent was found to damage very quickly, and would not contribute for long to the spectrum of the mixture. A laboratory sample of CaS was found to show the same yellow peak, and also to damage rapidly. There was insufficient osbornite to obtain a spectrum, but when a few crystals of it were observed visually under proton excitation no luminescence was seen.

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† We also found osbornite crystals in a sample of the Bishopville meteorite; this mineral has not, so far as we know, previously been reported anywhere except in the Bustee meteorite and its presence further emphasizes the great similarity between these two meteorites.