infundibular passages, they are also present in the caseous areas, in the neighbourhood of the phthisical cavities, and some can be demonstrated in the fibrotic areas surrounded by definite fibroblasts. One in particular (see Fig. 12) measured about 75 μ. It is clear and segmented in its middle part, but the extremities are nodular and clubbed. It is difficult to imagine that a foreign body of such length could be transported by phagocytes, but they may represent larger bodies left in a bronchus which has become obliterated. The bodies have been examined with the micro-spectroscope, but so far no clue as to their nature has been obtained by this means. They are not refractile by polarized light.

Nature of the Bodies.

We have shown these preparations to several pathologists, but the appearances are new to them. To confirm our own opinion we have submitted them to experts in zoology, who are unanimous that they are not of animal nature. We have also submitted them to botanical and chemical authorities, and though there has been a considerable difference of opinion, some regarding them as hyphomycetes, the general opinion has been that they are not vegetable forms.

The fact that exactly similar bodies have been found in the lungs of another asbestos worker, and, so far as I can ascertain, have not been found elsewhere, would seem to indicate that they are essentially derived from or associated in some way with the asbestos itself. It is also certain that they do not in any way resemble concretions, largely composed of calcium and other salts, and also containing iron derived from blood, such as have been described as streptothrix forms in the spleen, and which may closely simulate mycelial filaments. The hypothesis advanced is that these bodies are portions of asbestos fibres in the process of alteration and absorption by hydrolysis, either by direct chemical action or by enzymes. The particular variety of asbestos with which this patient worked was a Canadian serpentine (chrysotile). It would probably contain silica and a magnesium salt in about equal proportions (40 per cent.) with up to 3 per cent. ferrous oxide, 1 per cent. of alumina, and water. From its high resistance to heat we are apt to regard asbestos as indestructible, but, given time, it is possible for hydrolysis of such silicates to occur, even in pure water. Such hydrolysis would be hastened and intensified by the presence of CO_2 in the pulmonary alveoli, and the warm moist atmosphere there would, no doubt, accelerate the process. Even under these conditions the process would necessarily be a slow one. The magnesium could be separated out as relatively insoluble carbonate, or more soluble bicarbonate, which in turn would be converted into any other salt for which there happened to be the appropriate acid available.

The iron existing in a ferrous condition in the presence of an oxidizing agent might be converted into the ferric state, and subsequently precipitated as hydroxide. The silica might pass into a colloidal state, at first in sol form (orthosilicic acid), later passing into a gel (metasilicic acid). If this were so in sol form, it would tend to remain associated with the surface of the asbestos fibre by adsorption, and might be held there till it became a gel. In time the gel might adsorb the solution, and so gradual conversion of the fibre into a mass of gel would occur. *There might be in the tissues sufficient albuminoid material* to effect rapid gelatinization of the sol, particularly if, as would be the case here, the sol was being slowly produced. The fact that the gel is of high surface tension, and formed at an irregular rate, would give it a spheroidal structure and account for some of the appearances seen here. Whether this be the exact explanation or no, it is at least an hypothesis which should be capable of experimental verification. As has been held by Gye and others, in cases of silicosis there may be a direct chemical action of silica on the tissues apart from the merely mechanical irritation of the particles, with the production of fibrosis. Orthosilicic acid is, as has been shown, an active poison, but rapid conversion into metasilicic acid would minimize its action.

As to the relative part played by the asbestos and the tuberculous infection in this case, in relation to the [illegible] change, it is difficult to say, but it is a reasonable assumption that the tuberculosis was a superadded infection, and in Dr. Grieves's case referred to above there was in the sections examined a considerable degree of fibrosis without apparent tuberculosis. The immediate cause of death in that case was a terminal broncho-pneumonia. Till some experimental work is completed the exact nature of these foreign bodies must remain in doubt, but their highly characteristic appearance may well prove to be an important diagnostic point in the recognition of the lung of a worker in asbestos.

I am much indebted to Dr. Cooke for material from his case, to Dr. Grieve for an opportunity of examining his microscopical sections, to P. L. Robinson, D.Sc., of the Chemical Department, Armstrong College, for his advice and suggestions on the chemistry of the silicates, and to Professor W. H. Lang, F.R.S., of Manchester, for a reasoned opinion as to the non-botanical nature of the foreign bodies.

CLINICAL ASPECTS OF PULMONARY ASBESTOSIS.

BY

SIR THOMAS OLIVER, M.D., F.R.C.P.,

Consulting Physician, Royal Victoria Infirmary, Newcastle-on-Tyne; Emeritus Professor of the Principles and Practice of Medicine, University of Durham.

Dr. W. E. Cooke has given a short account of the history of asbestos, also of the processes of its manufacture into cloth-like structures much in the same manner as raw cotton fibre is woven. He has told us that in the carding department a considerable quantity of dust is evolved. The crushing of the rock is not carried on to any extent in this country; this is usually done in the countries where the mineral is quarried. Canadian rock is crushed in Canada so as to reduce the expense of transport to Great Britain. Our workers are therefore less exposed to the harmful influence of the dust—a fortunate circumstance, since the rock frequently contains as much as from 50 to 60 per cent. or more of silica.

With the exception of Dr. Cooke's paper on pulmonary asbestosis published in 1924, and the details of a fatal case published by Dr. Montague Murray in the *Charing Cross Hospital Gazette* in 1900, there has not been, to my knowledge, anything written in this country upon the subject. I have had, however, the opportunity of visiting asbestos factories in America, and of seeing cases of pulmonary asbestosis through the kindness of Drs. Haddow and Grieve of Armley, Leeds. It may, I think, be safely said that there must have been several deaths of workers in British factories from the malady, but as no autopsy and microscopical examinations of the lungs were made the deaths were probably certified as pulmonary tuberculosis.

Asbestos manufacture is largely a familial occupation. It has been carried on in this country only for a little over thirty years. Carding and spinning of the fibre are important processes in the manufacture of asbestos goods. In these departments many women are employed, mothers being succeeded by their daughters. Where ventilation of the carding and spinning rooms is properly attended to the atmosphere is fairly clear of dust and floating fibre, otherwise in these operations considerable quantities of dust become suspended in the atmosphere. In a British factory the dustiest process is "hand beating" of the finished mattresses used for covering and protecting the internal machinery of automobiles. This work should only be undertaken in a room separated from the main parts of the factory, with open windows at one end and strong down-draughts at the other, but even with this precaution men working therein should wear masks.

Recently, with Dr. Grieve of Armley, I examined two women who are the subjects of pulmonary asbestosis, one aged 48 and the other 39. The older patient was one of the first to commence work thirty years ago in the particular factory I visited. At that date no danger from dust was anticipated, so that no effective ventilation of the workrooms was attempted, such as prevails to-day. Although only 48 the first patient mentioned looks older by several years, and is extremely emaciated. She gave up work a year ago on account of increasing physical