FUNGUS INFECTIONS IN PEOPLE IN THE SUGARCANE BELT

By A. M. BEEMER, M.R.C.S., L.R.C.P.
C.S.I.R. Tuberculosis Research Unit, King George V Hospital, Durban.

It is a pleasure and a privilege to me to tell you something about cases of fungus infection I came across in people from the sugarcane belt. Two of these people are, I think, members of your association. I am grateful to them for allowing me to describe their symptoms and my findings, and to Dr. Dormer, Medical Superintendent of King George V Hospital, for allowing me to investigate and treat them.

The first case is a European male who, in 1945, after tasting burnt sugarcane, developed sores on the tongue and patches of inflammation on his face. The condition became worse during the next ten years, and in August of last year I saw him at King George V Hospital for the first time. He then had very extensive lesions all over his face, with considerable reddening and thickening of the skin on the ears, chin, nose and forehead. From the lesions on the face a fungus called “Geotrichum” was grown. As the inflammatory lesion appeared first on the tongue fourteen years ago, I thought that this fungus might also have established itself in the intestines, so I examined the patient’s faeces as well. A heavy growth of geotrichum (Fig. 1) was obtained from that source also. Dr. McMartin grew a fungus from lesions on the face of the same patient many years ago, and it was this interesting finding that really brought the patient to me ten years later.

Fig. 1

The fungus that Dr. McMartin grew, however, was Monilia sitophila, and Dr. McMartin informed me that this fungus is found very frequently on burnt cane. Medical mycologists regard Monilia sitophila as a harmless laboratory contaminant. It grows very rapidly and can cover a petri dish four and a half inches in diameter in a few days. A further complication, though, is the fact that geotrichum also is, very often, pathogenic. Species of geotrichum are isolated frequently from sputum, skin, and faeces of people without clinical disease, and diagnosis of geotrichosis is justified only if the fungus can be demonstrated repeatedly, and all other possible etiological agents excluded. Geotrichum does not spread on culture as Monilia sitophila does; and I think it is quite possible that the Monilia sitophila overgrew the geotrichum when Dr. McMartin first made his cultures from the skin lesions. Geotrichum was grown repeatedly from stool specimens from our patient, but Monilia sitophila failed to grow from that source. A very marked skin reaction was obtained by intradermal injection of a vaccine made from geotrichum. This reaction was much more pronounced than any resulting from vaccines made from other bacteria, and another skin fungus, (Epidermophyton floccosum). The geotrichum vaccine reaction remained prominent for a considerable time, and the skin condition flared up with the first administration. I think it is justifiable therefore, to conclude that this fungus was the cause of the skin lesions in this patient. Treatment which consisted mainly of desensitizing vaccinations, has produced a very gratifying improvement.

The second case was a field manager on a sugar estate, who developed sores on the tongue and lips, some three and a half years ago. These sores were extremely painful, and fresh ones appeared repeatedly until eight months ago, when the patient was given smallpox vaccinations every two weeks. The patient was referred to me in November, 1954. Culture from the tongue produced a mixed bacterial growth only (fungi were not grown). Culture of the stool, however, produced a growth of geotrichum. Treatment in this case also consisted mainly in desensitization, with a vaccine containing this fungus. Local therapy appeared to have no appreciable effect, and I think that the lesions must have been caused by an allergy due to the geotrichum. This patient’s present condition is also satisfactory and he has been free from sores for about six weeks. This is very much longer than any previous period of freedom.
from these painful and distressing sores and I think it is fair to conclude that allergy to the fungus isolated caused the patient’s symptoms.

The next three cases occurred in African males who were admitted to King George V Hospital with chest complaints.

**Case 3.** L.M. N3472. A Bantu male aged twenty-two years, whose home was in the Umzinto area, was admitted to King George V Hospital in 1951. He gave a history of persistent cough which began three months before admission to hospital. Within a week the cough became worse and the sputum was bloodstained. Numerous investigations gave no real clue as to the cause of the lung lesion. The X-ray showed that a lesion was present. It looked like a lung abscess, but culture from the aspirated material was always sterile. The patient was given antibiotics for bacteria in the sputum without good effect. Examination of the stool showed the presence of round worms, hook worms, tape worms and some flagellates. We thought that the previous failure to respond to treatment might have been due to these parasites. However, the lesion increased in size radiologically, despite all treatment, including that for the parasites. It was finally decided to operate and remove the affected lung. This was done on the 16th January, 1952. The excised lung showed that one lobe was almost completely destroyed and replaced by pale tissue surrounding a big ragged abscess (Fig. 2). The histology showed chronic inflammatory changes, with many giant cells and marked fibrosis. Special stains revealed the presence of fungal elements (Fig. 3). Unfortunately no fungus was grown from this lung because the tissue had been fixed in formalin immediately after operation. The patient died six months later, and areas of softening were found in the brain. A fungus, *Aspergillus fumigatus* (Fig. 4) was grown from these areas. I think there can be no doubt about the cause and pathogenicity of the organism in this case.

**Case 4.** M.P. N4612. An adult Pondo male, aged forty-two years, whose occupation was given as a sugar mill labourer, was admitted to King Edward VIII Hospital in January, 1953, complaining of cough for about a week and pain in the right chest. He was given various antibiotics and discharged in March, 1953. In September he was re-admitted to
King Edward VIII Hospital, complaining of abdominal pain and diarrhoea. He still had pleuritic pain and bloodstained sputum, but these were secondary symptoms. However, he was transferred to King George V Hospital because of the chest condition. There was no subjective improvement despite antibiotic treatment, good food and treatment for whip worms, tape worms and hook worms, ova of which were found on stool examination; so pneumonectomy was performed on 1st March, 1954. The excised lung looked firm and fibrous and unlike any form of lung disease I had ever seen (Fig. 5). However, I think it resembles the lungs described in pneumokoniosis due to inhalation of cane dust. Sections of the excised lung showed the presence of numerous fungal spores and a fragment of mycelium in a giant cell (Fig. 6).

Case 5. R.D. N5318, was a Bantu male, admitted to King George V Hospital in November, 1953. He had worked in cane fields for the last five years, cutting and weeding. Six months before admission he developed a productive cough and bloodstained sputum. Despite antibiotics for the various organisms isolated the condition did not improve and in January, 1954, pneumonectomy was performed. Again fungal elements (Fig. 7) were found in sections taken from the excised lung, which was firm and fibrous and also resembled the lung excised from Case 4.

These last three cases are particularly interesting, I think, because of a possible relation to a disease named "Bagassosis," which occurred in England and America in men who were engaged in breaking up bales of cane for the manufacture of hardboard. Most of the sugar had been extracted from the cane, but what little was left formed a good culture medium for many different organisms, including moulds, which contaminated the bagasse on arrival. The disease bagassosis was first recorded in the New Orleans Medical and Surgical Journal in 1941, by Jamison and Hopkins, who described a disease of the lungs where the main symptoms were cough, shortness of breath, and a thick sticky sputum occurring in a man who had been unloading bagasse in America. In the British Medical Journal, October 1942, four similar cases were reported by Castleden and Hamilton-Paterson, and in the same year, four cases were reported by Gilleson and Taylor. I have found no record of any case of bagassosis in South Africa, but the three cases I spoke about might well be late results of repeated and long standing inhalation of cane dust. The actual substance in bagasse that caused the disease in England and America, has not been identified with any certainty. Bagasse is mainly fibre, 1 per cent. of
which is protein and 5-7 per cent. is silica. Although the amount of silica is sufficient to produce silicosis, the actual acute pneumatic symptoms differ from any other known and described form of silicosis. Also the pneumonectomy specimens in the three cases at King George V Hospital did not look like silicosis. Jamison and Hopkins considered that a fungus which they had grown from two specimens of sputum from their case, was the cause of the disease. Castledon and Hamilton-Paterson failed to grow any fungus from the sputa of their cases. However, they made saline and other extracts from bagasse which they tested out intradermally in twenty individuals. It was interesting that only three gave positive reactions, and these were patients who had suffered from the disease bagassosis. As the investigators had failed to grow a fungus they concluded that the whole bagasse contains an antigen to which workers, who inhale the dust, can become sensitized; and they hypothesized that the acute phase of bagassosis is an allergic response in the lungs to this antigen.

As soon as the disease was recognised as an occupational hazard, precautions were taken to avoid further exposure to bagasse dust, and none of their patients died.

The failure to grow the fungus, before operation, from any of the three lung cases at King George V Hospital may have been due to the fact that we were not sufficiently aware of the possibility of a fungus being the cause, so requests for fungal examinations were not made. Furthermore, Aspergillus fumigatus is ubiquitous. It grows on plants and grain and straw and bagasse and is often a most troublesome laboratory contaminant. This has led to much dispute about its pathogenicity. However, I think there can be no doubt that Aspergillus fumigatus was pathogenic in the patient who died from Aspergillus fumigatus abscesses in the brain. Although Aspergillus fumigatus was not grown from the other two cases I think that the histology is very similar to that in the proved case of Aspergillus fumigatus infection and that this fungus caused the disease in the lungs of these particular patients.

These cases have really a double interest and importance. I, myself, am of the opinion that they are a late stage of the disease called bagassosis, and as such may help to elucidate the cause of the disease and also may explain odd respiratory complaints that Dr. Labuschagne told me occur in cane workers. Furthermore, as bagassosis is a recognized occupational hazard, I think that all precautions should be taken to avoid inhalation of cane dust, with its associated fungi and foreign proteins. The precautions I would suggest are:

1. Regular medical and radiological examinations, so that early lesions can be treated.

2. Debilitating conditions, like worm infestations, should be treated. Round worms and hook worms spend part of their life cycle wandering through the lungs and this may produce a suitable nidus for growth of Aspergillus fumigatus.

3. Long hours in a cane dust polluted atmosphere should be avoided, particularly in mills where there is a heavy concentration of the dust.

4. Special extraction fans should be installed, as was done in England and America.

The part that fungi played in causing the pathological condition in the first two cases is, I think, fairly clear, and workers should avoid tasting burnt cane if possible. If this is not possible, rinsing the mouth and washing immediately after may be adequate safeguards.

Now I have given you my views on the part fungi have played in the cases described, but opinions do vary.

Perry, at the Proceedings of the Ninth International Congress of Industrial Medicine in London reported the presence of Aspergillus fumigatus in all specimens of bagasse dust he examined, but he considers that these organisms play no part in causing the disease. Gerstl et al, in Proceedings of the Society of Experimental Biology, vol. 70, 1949, however, reported pneumonic lesions in rabbits after administration of bagasse and from these lesions Aspergillus fumigatus was isolated. They also found that if bagasse was first autoclaved and then administered to rabbits, no pneumonic lesions occurred and they concluded that the pneumonic lesions were due to micro-organisms in the bagasse.

There is a huge field for research in Natal. If mass radiography of field workers could be organised at regular intervals—and sputa cultured for fungi and symptoms correlated at regular medical inspections, we should get much useful information.

It should also be possible to sterilize bagasse and then contaminate it with a pure culture of Aspergillus fumigatus only, and administer to rabbits to see if pneumonic lesions can be produced without other mixed organisms. It is hoped that we shall be able to organise all this research.

The President said he was very much indebted to Dr. Beemer for diagnosing some obscure skin and lung troubles affecting workers in the sugarcane industry, and his work, he was sure, would be appreciated throughout the sugar world.

This was something new to the sugar industry, but it seemed a very important problem and he hoped that Dr. Beemer could continue his research. He
thought that the danger from bagasse might be linked with those normally attributed to smog. It was noticeable that in Cuba very high chimneys were used in order to carry the smog and bagasse char dust far away from the factories. These conditions unfortunately did not apply in Natal. He was disappointed that more medical men were not present to hear this most interesting and important address.

Mr. Rault said it was obvious, any time when visiting a sugar factory, how much bagasse dust was flying about. He thought the irritation caused by such dust might contribute to the occurrence of throat and lung troubles. He asked whether the silica mentioned by Dr. Beemer as a constituent of bagasse could play a part.

Dr. Beemer replied that though there is enough silica in bagasse to cause silicosis, various investigators showed that silica was not the cause of bagassosis; clinically, too, bagassosis did not resemble silicosis. It was not known if the fibre caused the disease, but it might play a part, as by blocking small air passages, it might damage the lung and so produce a nidus for the fungus to grow. The question however was still unsolved and required further investigation.

Dr. McMartin thought we should be indebted to Dr. Beemer for putting down on paper something which might develop into an important field of medical investigation. Ten years ago he contracted a disease of the ear from which he isolated the fungus aspergillus and he had read that this type of fungus could also affect the lungs. He had mentioned this to Dr. Beemer, and also said that at that time when he had the ear infection, they were experiencing a minor epidemic of the infection amongst people working with sugarcane, and several fungi could be isolated from the ears of these people. He found that there was so much work involved in following this up that he passed it on to the Government Pathologist in Durban who thought that the climatic conditions were ideal for developing fungi which could affect human beings, more than had been realized in South Africa. He considered this was something which should engage the attention of the sugar industry. He agreed with Dr. Beemer that research of this nature should be carried further and said that this research deserved the financial support of the industry.

Mr. Bax knew of a case in Mauritius where a factory worker contracted an eczema of the arm which was thought by some to be due to infection by bagasse. By changing his place of residence he became cured, but on return to his factory residence the eczema returned. He asked Dr. Beemer if it were possible that such a diseased condition might be caused by bagasse.

Dr. Beemer replied that he thought that this was possible. Many different foreign proteins cause eczema and the two cases of skin and mouth lesions described had produced enough evidence to make him consider that fungi from bagasse might well cause other allergic manifestations, like eczema.

Mr. Park asked if there were any antidotes to combat the effect of such fungi.

Dr. Beemer replied that there were various substances used in fungus infections and that he had made vaccines from the patient's own organisms which had helped, and he hoped to be able to pursue this work.

Mr. Bax asked Dr. Beemer if he considered that a mere change of climate, as in the case he had mentioned, would be enough to cure a patient of such a condition.

Dr. Beemer said such cures were known to occur.

Dr. Brett said he understood that worm infestations were very common in labourers in the sugar industry and he asked Dr. Beemer if, by eliminating these worm conditions, the fungoid attacks might also be eliminated.

Dr. Beemer thought that debilitating infestations with worms, particularly with worms that spend part of their life cycle in the lungs, could also play a part in predisposing to bagassosis, but they only play a part, and until further work was done he could not venture an opinion on how important that part was. He thought however that Dr. Labuschagne would agree with him that every person living in this coastal climate should have such parasitic possibilities investigated. If all labourers were examined and treated for such parasitic conditions the output from our local labour would improve tremendously.

Dr. Labuschagne was of the opinion that many respiratory conditions might be due to conditions other than those normally accepted. Many cases ascribed to normal causes might be due to something unknown to us, and while he was not in a position to state this opinion definitely, the matter would bear further investigation. He had wondered if bagasse particles for instance with their sharp edges, could produce similar conditions to silicosis. It might even lead to a tubercular condition. He said, as far as worms were concerned, they were extremely prevalent among sugarcane workers. He thought that some of the laziness of workers who complained of many symptoms was really attributable to parasitical worm conditions.

The President said Dr. Beemer was to be thanked for bringing this matter to the notice of the local sugar industry and he thought it should also engage the attention of the C.S.I.R. He concluded by saying that he hoped the paper would be published by the sugar journals of the world.