Mocharas and the Genus *Haematomyces*.

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With two Figures in the Text.

THE genus *Haematomyces* was established by Berkeley and Broome in 1873 (Jour. Linn. Soc., xiv, p. 108) on a specimen sent from Ceylon by Thwaites. The generic description runs as follows:

'*Haematomyces. Tremelloides, sinuato-lobatus, gyrosus, subcerebrinus, immarginatus; asci vesiculares; sporidia elliptica.*'

The type species was named *Haematomyces spadiceus*, B. and Br. No formal description of the species was given, but it was said to look exactly like a *Tremella*, and to have spores, $6.25\ \mu$ long, which bore a small proportion to the wide, obovate, vesicular asci. Berkeley and Broome added the note, 'There can be no doubt that the genus is good; but it is to be hoped that a further supply of specimens will be procured. The asci are quite unlike anything in Bulgaria, to which we were at first inclined to refer it. Black when dry.'

The genus was duly included in Saccardo, 'Sylloge Fungorum,' in the *Bulgarieae*. Another species had by that time been described by Peck, viz.:

Haematomyces orbicularis, Peck, *Sessilis, pulvinatus, orbicularis, subtremellosus, gyroso-convolutus, nigricanti-brunneus, particulis minutis rufis punctatus; ascis anguste clavatis, apice subacutis; sporidiis oblongo-fusoides, continuis, $15-18 \times 3-4\ \mu$; paraphysibus numerosis, filiformibus.*

The generic character on which Berkeley and Broome laid so much stress, viz. the obovate, vesicular asci, was apparently considered of minor importance.

Subsequently Peck added a third species:

Haematomyces fagineus, Peck, *Tremelloides, cerebriformis, 2-2.5 cm. diam., gyroso-lobata, glabra, nitens, extus intusque rubra (raisin colour); ascis subcylindratis, 8-sporis, $60 \times 7.5\ \mu$; paraphysibus gracilibus, supra lenissime incrassatis; sporidiis plerumque monostichis, anguste ellipsoideis, $7.5 \times 3.5-5\ \mu$. Ad truncos Fagi ferrugineae. Habitus Tremellae.*

A fourth species was described by Rick from Brazil:

'*Haematomyces eximius*, Rick, *Ascomate gelatinoso, cerebriformi et tremelloideo, prorumpente, convolutionibus crassis, firmis, globoso, 5 cm. diam., castaneo; ascis cylindraceis, 130 × 6–8 μ; sporidiis ellipsoideis, 6–8 μ longis, 4 μ cr., biguttulatis, apiculatis v. etiam apice truncatis, viridulo-hyalinis, dein olivascentibus, biserialibus, unilocularibus; paraphysibus filiformibus, apice paulatim minute incrassato, hyalinis, versus pedem viridulo-olivaceis.*'

And Rick adds '*Haemat. spadiceo affinis*', a remark which strikingly illustrates the futility of comparisons based on descriptions only.

In 'Fragmente zur Mykologie', VI. Mitt., p. 126, von Höhnelt writes, 'Another Discomycete genus with an immarginate disc is *Haematomyces*, Berk. This genus appears to me to be an immarginate *Ombrophila*. Presumably those species of *Psilopeziza* which are brilliantly coloured (*flavida, aurantiaca, xylogena, aquatica*) would be better regarded as species of *Haematomyces*.

'To this genus, no doubt, belongs also *Pezizella orbilioides*, Feltgen ('Vorstud. Pilzflora von Luxemburg,' III. Nachtr., p. 53), which I formerly referred to *Ombrophila*. It must now be named *Haematomyces orbilioides*, (Feltg.) v. H. It corresponds admirably with this genus.'

Apparently the accepted idea of *Haematomyces* is a pulvinate, convoluted, or cerebriform stroma, more or less gelatinous or tremelloid in consistency, which bears a palisade layer of asci and paraphyses over the whole of its exposed surface, without any definite margin. The spores are continuous and hyaline. None of the descriptions states explicitly that the asci are arranged as suggested, but that conclusion appears to be warranted by the inclusion of the genus in the Bulgariaceae. Berkeley and Broome made the shape of the asci a generic character, but that has been ignored by all the describers of subsequent species.

Berkeley and Broome's material appears to have been scanty. There is a specimen, part of the original gathering, in the Peradeniya herbarium, but as for twelve years I did not meet with any species which coincided with the current idea of *Haematomyces*, it was not examined. During 1918, however, I collected, in the low country, an ascomycete which formed a pulvinate, cerebriform stroma, up to 1.5 cm. diameter, purple-red to flesh colour, and somewhat subtranslucent and tremelloid. The whole of the exposed surface was covered by a palisade layer of asci. As this species appeared to agree with the description of *Haematomyces*, an examination of the cotype was undertaken.

The cotype in Herb. Peradeniya (Thwaites' 59) was evidently obovate when fresh, about 8 mm. high, and 5 mm. broad. It has become laterally compressed in drying, and slightly folded towards the apex, but it is scarcely 'subcerebrinus'. Its colour is dark purple-brown, and its surface minutely rough. On cutting sections, it is found that *there is no palisade*

layer of asci. The stroma consists of a dense brown cortex, about 100 μ thick, succeeded internally by paler tissue, or by alternate zones of hyaline and brown tissue. This tissue shows numerous lines which appear to be the walls of partially disorganized hyphae. These walls run irregularly for a short distance, usually strongly and closely flexuose, and are then lost in the general mass. But the general arrangement of these walls is concentric, and parallel to the outer surface.

Surface sections show that the exterior is composed of large, more or less polygonal cells, but as these do not appear in the cross-section they are evidently very thin, or have collapsed.

Embedded here and there in the internal tissue are the wide, obovate, vesicular asci noted by Berkeley and Broome. These may reach a length of 100 μ and a breadth of 40 or 50 μ . They contain a varying number of subangular bodies, which are sometimes arranged in a row, but more usually lie in a group on one side of the cell, and occupy, as stated by Berkeley and Broome, only a very small part of it.

It will be evident that this structure is not that of the *Bulgarieae*, and that, if it were a fungus, *Haematomyces* would have to be classed perhaps in the *Plectascineae*.

On staining with cotton blue in lactic acid, the whole of the tissue turns pale blue, but it does not swell up to any marked extent. But on staining with iodine, the apparent spores stain black and are evidently starch or amyloid grains. This immediately renders it improbable that the obovate bodies are asci, and that the specimen is a fungus.

On considering the matter further, it occurred to me that *Haematomyces spadiceus* was not rare, but was to be found in abundance at Peradeniya. Moreover, I had frequently examined it, without ever suspecting that it might have been mistaken for a fungus. Fortunately, fresh material happened to be available at the time, and an examination of it confirmed the idea suggested by the type specimen.

AN EXUDATION FROM *BOMBAX MALABARICUM*.

One of the most conspicuous trees at Peradeniya is the Bombax (*Bombax malabaricum*, DC.), the red cotton tree, and most visitors to Peradeniya remember the row of giant trees which borders the road from the station to the Botanic Gardens, especially if they have passed that way in the early part of the year when the ground is covered with its large, red, shuttlecock-like flowers. The tree is a rapid grower, and its wood is brittle. Consequently its huge limbs are frequently wrenched off by the wind, and, as they are of little use except for firewood, they are left lying until they begin to decay. As seven trees of the row referred to stand along the frontage of my garden, I have had several opportunities during the last twelve years of observing the changes which take place in the fallen branches.

After a branch has been lying on the ground for a few weeks, it begins to exude, through cracks in the bark, a yellowish, pasty, somewhat viscid substance. This appears in pulvinate masses, or runs down the side in thick strands, assuming all the varied forms associated with an exudation of gum or resin. If the cortex has been stripped off any part of the branch, this substance emerges from between the wood and the cortex, i.e. from the site of the cambium, and it issues from the same place on the cut end of a fallen branch or stem. It soon acquires a yellow-brown, polished, outer skin, and this increases in thickness and deepens in colour as the exudation ages. Sometimes the skin ruptures under the pressure of the exuding mass, and further projections grow out from the apex of the structure first formed. When old, it is red-brown to purple-brown, usually with a polished surface. As it dries it hardens and contracts, sometimes falling into irregular folds and convolutions, sometimes retaining its shape but becoming hollow. This exudation is *Haematomyces spadiceus*.

The following recent occurrence illustrates its usual mode of appearance. A branch about 35 feet long, and 9 inches in diameter at the butt, was blown down at the beginning of July, during the rains. In falling, the outer half of it lodged in a small tree, so that it stood in a nearly vertical position with the thicker end on the ground. During August, the upper part of the branch, above a height of 20 feet, produced numerous green shoots, while the lower end which rested on the ground began to produce the usual exudation. During dry weather in September, shoots arose from the lower end also, and the condition on September 24 was as follows: The exudation was issuing from cracks in the lowest 4 feet, and the same region bore green shoots up to a length of about 9 inches, but the shoots were situated chiefly in the lowest 2 feet 6 inches. On the next 10 feet above that, the bark was dead, but the uppermost 20 feet bore green shoots, up to a foot in length, without any exudation. During a week's drought at the end of September, the shoots on the upper part began to wither, and the exudation began to issue in small amount from the same region. It would appear from this, and other similar observations, that this exudation is only formed in living cortex. When, on a fallen branch or stem, a bud bursts through the cortex, the yellow mass frequently appears at or near its base.

MOCHARAS.

This exudation from the *Bombax* has long been known in India, where it is sold as a drug in the bazaars under the name of Mocharas, or Mochras, or Mocherus, &c. Mocharas means the juice (*ras*) of the Mocha, the latter being the Sanskrit name of the *Bombax*. The 'Dictionary of the Economic Products of India' describes it as a brown, astringent, gum-like substance, which occurs in the form of light or dark brown tears, often hollow, and much resembling galls. Owing to the usual confusion attending the native

names of drugs, there was formerly some difference of opinion whether Mocharas was obtained from the Bombax or the Areca palm. Birdwood, as quoted by Cooke, favoured the latter, and stated that all his attempts to obtain gum of any kind from Bombax completely failed in Bombay, and he had no hesitation in saying that the red cotton tree afforded no gum whatever. It is, however, now definitely settled that Mocharas is the produce of the Bombax, and Birdwood's failure to obtain anything of the kind from standing trees is quite in agreement with the experience of other observers.

Mocharas was included in the collection of Indian gums and resins submitted to Cooke and is referred to by him on p. 40 of his Report. He quotes from the Pharmacopæia of India that 'The astringent gummy exudation occurs in opaque, dark-brown, knotty pieces, some presenting a remarkable gall-like appearance, inodorous, of a strongly astringent taste.' Cooke included it in his section on Astringent Gums, and stated that many pounds of it had been broken up, but no evidence had been found that it was an insect gall. 'They are not galls, but gall-like exudations, for there is every appearance of their having exuded, in a manner similar to gum, in a semi-fluid state.'

Some further light was thrown on the subject by an article by B. H. Baden-Powell in the 'Indian Forester', viii (1882), pp. 153-5. The following extract is quoted from his account:

'In my garden at Lahore there are two large and well-grown Bombax trees, which must be as old as the very earliest British resident who came to Lahore, if not earlier. . . . I detached bits of the bark from one of these trees, made incisions, cut into the surface only, and down to the sap-wood, but no gum or any other exudation of any kind appeared. But the other tree, which divides into two stems at about eight or ten feet from the ground, is covered, as to its lower part, with a clustering mass of the lovely "pink coral creeper" (*Antigonum leptopus*). Having occasion to trim this, and remove the old stems or bine, I disclosed the surface of the tree, and saw that, close to the fork of the two branches, the stem was somewhat swelled, the bark was all broken up and excoriated, as if in fact a large sort of unhealthy swelling sore was there: a mass of brownish or blackish powder, or rather friable grains, had also fallen and collected at the foot of the tree. This residue looked rather like the excreta of some insects boring into the bark, but I could not detect any trace whatever of any bark-eating insects, or any aphides, &c. A great deal of this powdery stuff was to be brushed off the wood itself, seeming to come from the disintegration of the bark over the sore. From all parts of this sore I found great masses of the Mochras which had exuded and dried there: much of it was old and partly rotten, but some that was fresh looked like deep brown bubbles or shells that had irregularly contracted in drying. I cleared away all the powder, and picking out the best bits of Mochras to go to Dr. Cooke, I cleared away the

old rotten stuff. After a few days, I observed new Mochras form: to my surprise it issued in various shaped masses, or worm-like pieces, as if one squeezed oil paint out of a tube; this gradually curled up or coagulated into a mass as chance would have it. It consisted of a rather firm, slightly translucent, dirty whitish-yellow jelly.

'To the taste it was almost insipid, but with a slight roughness indicating astringency. It proved wholly insoluble in cold water, and nearly so in boiling water, though I think it went into a pulp under such treatment. It did not appear, either, soluble in pure spirits of wine, but imparted a red colour to the liquid.

'This jelly, when dried by the air and heat of the sun, acquired a dark brown colour; the surface dried first, and the inner part gradually shrunk afterwards, accounting for the blister-like irregular pieces. This then is Mochras (at least one kind of it).'

The above experience differs from that of other observers in that the exudation was obtained from a living, though damaged, tree. But it agrees with others in that wounding the tree did not induce its formation.

Dymock, in the '*Materia Medica of Western India*', gives the following information regarding Mocharas:

'When first exuded it is a whitish fungous mass which gradually turns red, and finally dries into brittle mahogany-coloured tears. The larger tears are hollow in the centre, the cavity being produced during the gradual drying of the jelly-like mass which first exudes. Dry Mocharas when soaked in water swells up, and resumes very much the appearance of the fresh exudation. The taste is purely astringent, like tannin.

'Mocharas is not a simple juice, but the product of a diseased action, which consists in a proliferation of the parenchyme cells of the bark. Upon making a section of the diseased part a number of small cavities are seen which contain a semi-transparent jelly-like substance, consisting of oblong cells with botryoidal nuclei. At the margin of the cavity the columns of healthy cells are seen breaking up, and the cells separating to join the jelly-like mass: this gradually increases in size and finds its way to the surface to be extruded as Mocharas. Upon its first appearance it is of an opaque, yellowish-white colour, firm externally, but semi-fluid internally, and there is no central cavity. The cause of the diseased condition of the bark which produces Mocharas has not been determined.'

Dymock further states that Mocharas only exudes from portions of the bark which have been injured by decay or insects.

The majority of observers have recorded that they have not been able to induce the formation of this exudation by wounding a healthy tree. There is some possibility of error in these observations, owing to the peculiar character of the *Bombax* cortex. On a well-grown tree, the cortex at the base of the stem is very thick, and the inner layers readily

separate into thin sheets. When a piece of cortex is cut out, it may split off along one of the inner layers, and unless the exposed tissue is examined microscopically, one is very apt to mistake the smooth, white, cortical layer for the surface of the wood. It appears to be essential for the formation of Mocharas that the wound, on a living tree, should extend to the cambium.

The following observations were made at Peradeniya on the foregoing point, during October, 1918:

A rectangular piece of cortex, about 6 cm. by 4 cm., was cut out, down the wood, from the stem of a young tree about 30 cm. in girth. The cortex was 6 mm. thick. No Mocharas was formed.

Fourteen young stems, of about the same girth as the last, were pollarded at a height of about 4 feet. In one case, a small quantity of Mocharas emerged, about six weeks afterwards, at one point on the cut surface, from between the wood and the cortex. In another, the pollarded stem produced new shoots near the apex, one of which was wrenched off later, and a small quantity of Mocharas was subsequently produced where the young shoot had been torn off.

A piece of cortex, about 5 cm. square, was cut out of the stem of a well-grown tree at a height of 4 feet, the girth of the tree at that height being $12\frac{1}{2}$ feet. The thickness of the cortex was 35 mm. About three weeks afterwards, Mocharas emerged in small quantity from the line of the cambium, the total amount not exceeding a cubic centimetre. It issued chiefly along the lower edge of the opening.

Mocharas, therefore, can be obtained by wounding standing trees, but the quantity is very small in comparison with the amount which issues from fallen branches or felled logs.

THE STRUCTURE, ETC., OF MOCHARAS.

At Peradeniya, Mocharas occurs on sound branches which have been broken off by the wind, or on felled Bombax, in either case after they have been lying on the ground for a few weeks. It issues as a yellowish-white pasty mass, soft and only slightly viscid. The surface soon becomes yellow and forms a thin, polished skin, while the inner part remains, for some time, whitish, subtranslucent, and soft. If it is broken, the inner tissue rapidly turns brown. Finally, it dries and hardens, becoming red-brown to purple-brown: sometimes the outer skin collapses and the mass becomes irregularly folded, but in other cases it retains its shape and becomes hollow internally.

When examined in an early stage, the soft, internal tissue is found to be composed of large cells, either spherical, 40–90 μ in diameter, or more generally oval, up to $130 \times 100 \mu$. These are thin walled and readily collapse. Each of them contains a varying number of small, subangular,

starch (or amyloid) grains, from half a dozen to over fifty, usually in a group towards one side of the cell. As a rule the cells are free from one another, but sometimes a few may be united in pairs. They are bound together by a comparatively small quantity of a finely granular slime. The external covering consists merely of an outer layer of the same cells, browned, collapsed, and glued together by the hardened slime: it may attain a thickness of 100 μ .

If the cortex from which *Mocharas* is issuing is stripped off the wood, a thin layer of the same substance is usually found lying between the two. This layer is not continuous, but is interrupted by small islands of tissue from one to five millimetres in diameter, or sometimes by large continuous sheets. There are also other smaller masses of tissue, projecting from the

surface of the wood, or the inner surface of the cortex, but lying beneath the slimy layer. These patches are usually more numerous on the cortex than on the wood. On exposure the slime rapidly turns brown.

FIG. 1. Inner surface of the cortex of *Bombax malabaricum*, when producing *Mocharas*. The white areas are unaltered cortical tissue; the intervening shaded spaces are the galleries. Natural size.

On cutting out a piece of the cortex, with the underlying wood still attached, the following conditions are found: Immediately external to the wood is a layer of parenchyma, consisting of rectangular cells arranged regularly in radial rows. This layer may be 2 mm. thick. The cells do not contain any of the sphaerocrystals which are a prominent feature of normal *Bombax* cortex, and the layer lacks the lignified fibres which occur so abundantly in the outer normal tissue.

Instead of the latter, there are usually two, sometimes three, longitudinal bundles of lignified vessels, often running somewhat irregularly, with scalariform thickenings. These vessels, like the normal *Bombax* cortical fibres and stone cells, give the usual lignin reaction with phloroglucin. They may run singly through the parenchyma, or be united in bundles of two or three. Sometimes they bear a slight resemblance to the vessels of the *Bombax* wood, though much smaller in diameter, but as a rule they are distinctly scalariform. The walls of this parenchyma do not stain with Sudan glycerine: a number of globules in the cells take the stain, but this occurs also in normal cortex. The walls are stained yellow-brown by chlor-zinc-iodide: they do not stain with phloroglucin.

No layer corresponding to this is found in normal *Bombax* cortex. In the latter, the cortex consists chiefly of rows of lignified fibres, with narrow

bands of parenchyma up to 0.5 mm. wide. The cells of the normal cortical parenchyma contain large numbers of starch grains, and many contain large sphaero-crystals.

The examination of this abnormal cortex and the exudation has been rather of a preliminary character, as it was undertaken chiefly to determine whether *Mocharas* was a fungus or not. Many interesting, and apparently novel, features await further investigation.

When the cortex is exuding *Mocharas*, this tissue is permeated by numerous galleries parallel to the cambium and anastomosing freely. In an advanced stage, the cortex is in some places separated from the wood, or divided tangentially by cavities which leave only a few layers of cortical parenchyma overlying the cambium, while in other places it is united to the wood by narrow columns of parenchyma. Hence when it is stripped away from the wood it presents the irregular appearance already described.

FIG. 2. Longitudinal section of the cortex of *Bombax malabaricum*, when producing *Mocharas*. Diagrammatic. A, wood; B, abnormal cortex; C, normal cortex with lignified fibres; D, galleries of *Mocharas*; E, browned tissue, showing extension of *Mocharas* formation; F, lignified vessels.

The formation of *Mocharas* begins with the disorganization of a small group of parenchymatous cells, and extends until a gallery is formed. The gallery, in section, may be circular, but is more usually narrow-oval, or oblong with rounded ends, the long axis of the gallery being parallel to the cambium. In the cases observed, this has generally begun about the middle of the abnormal cortical zone.

The radial rows of unaltered cortical cells meet the long flatter sides (i. e. the outer and inner) of the gallery perpendicularly, but at the curved boundary they may be displaced so as to be normal to the curve. The narrow radial boundary of the gallery usually abuts on a normally radial row of cells, and in many cases a wedge-shaped mass of browned cells stretches from this boundary through the parenchyma, parallel to the cambium, indicating an early extension of the gallery in that direction. All the cortical cells round the gallery are in a state of rapid division by cross walls parallel to its surface, except, in some cases, those which border on the shorter sides where the gallery is in process of extension laterally.

The first appearance noted in the cells which are undergoing transformation into *Mocharas* is a browning and swelling of the cell-walls.

This swelling appears to take place in the inner layers, i. e. those bordering on the lumen of the cell. At the same time hyaline globules appear on the inner surface of the cell-wall and increase in number until in some cases they almost fill the cells: frequently these globules form short chains, or are united in botryoidal masses. The cells then separate along the middle lamella, and intercellular spaces are formed which become filled with slime. The loose cells lose their brown colour, and their walls are reduced to a thin membrane and collapse. These collapsed cells, embedded in slime, completely fill the gallery with a disorganized mass.

The globules on the cell-walls, or in the cells, at first stain yellow-brown with chlor-zinc-iodide. They do not stain with Sudan III. But in the older modified cells, they stain black with chlor-zinc-iodide. This change appears to take place from the centre of the globule, as many of them stain black in the centre, with a yellow-brown translucent margin. It thus appears that these starch (or amyloid) bodies are formed from some constituent of the cell-wall. The grains observed in the cells of the exuded Mocharas are not the residual starch of the cortical parenchyma. On staining a section of the abnormal cortical layer with chlor-zinc-iodide, it is very noticeable that while innumerable granules in the disorganized mass stain black, nothing of the kind occurs in the surrounding unaltered parenchyma. There is no starch in the unaltered cells of the abnormal cortical layer.

A similar formation of Mocharas takes place in the old normal cortex in small pockets between the fibres, but this occurs only to a small extent, and it does not seem to contribute much to the amount exuded. The chief source of the exudation is the abnormal layer of cortical parenchyma which is developed after the tree is felled. Consequently, Mocharas exudes principally along the line of the cambium, or from cracks which extend almost completely through the cortex.

The lignified vessels of the abnormal cortical layer do not form part of Mocharas. They are pushed to one side, as the galleries are enlarged by the disorganization of the surrounding cells.

When the mass exudes, the cells expand and assume an oval or spherical shape. A few are brown, with brown contents, but the majority are hyaline, and contain a cluster of amyloid bodies. No crystals occur in the exudation. The red-brown or purple-brown coloration of the outer layer appears to be produced not only by exposure to the air, but also by a transfer of some colouring matter from the interior outwards. When first exuded, Mocharas is pale yellow, or yellowish white, but when the outer layer has turned red brown, the interior appears distinctly whiter.

When a piece of Mocharas, about three or four weeks old, was boiled in water, it swelled up and resumed its original shape. At the same time its colour changed to yellow, and the water became deep red. When left

in water, the inner part swelled further, burst the outer wall, and issued in mucous-like masses.

When Mocharas from the same sample as above was immersed in cold water, it swelled up and resumed its original shape more gradually. The colour of the outer layer remained unchanged, but the water was nevertheless tinged brown. After twenty-four hours, the outer layer had split and the inner part was emerging in white masses. Twenty-four hours later, these extruded masses had swollen still further and their boundaries were translucent.

The reactions yielded by this substance with different reagents vary in some degree with its age or condition. For example, when it is two or three days old and has acquired a thick, outer, brown coat the behaviour of the internal white mass is not quite the same as that of freshly exuded material, which is covered merely by a thin yellow-brown skin. The differences, however, are in degree only.

In water, material taken from the interior of a piece two or three days old swells up slightly into a translucent jelly in which the individual cells are visible, more or less in lines, like the ova of some aquatic animal. The water is coloured brown almost immediately. The external brown layer does not undergo any appreciable change. The same phenomena occur when this material is immersed in a 5 per cent. solution of cane sugar, but the liquid usually is not coloured and the swelling is generally greater.

When freshly exuded material is immersed in water, it spreads out in an opaque, cream-coloured, slimy layer over the bottom of the tube, the water being coloured brown as before. Some part of the original mass may retain its shape, but the bulk of it spreads out over the base of the tube, instead of swelling up into a definite, pulvinate, translucent mass, as in the case of the older material. In a day or two, the slime swells still more and extends up the tube, driving before it the brown liquid, but still leaving an opaque, creamy layer at the base. In 5 per cent. cane sugar solution the same happens, but the liquid in this case is tinged brown, though only slightly, and more of the original mass remains coherent than in water.

If the freshly exuded material is fixed to the side of the tube, in water, the bulk of it falls to the bottom and forms a creamy layer as before, but some of it remains adherent to the side, and swells into translucent strands in which the cells are embedded. No difference has been observed in the reactions of these two portions, except as regards the starch grains. Those in the cells which sink to the bottom turn evidently blue in chor-zinc-iodide, but those in the cells in the strands take at first a brownish tinge, before becoming opaque. Treated in the same way in 5 per cent. sugar solution, comparatively little falls to the bottom of the tube, the bulk swelling into a cream-coloured mass still adherent to the side.

Alcohol, ether, and chloroform have no action on either fresh or old material.

In 10 per cent. caustic potash, the slime swells up and dissolves. In small quantity, on a slide, the material turns red-brown, but when immersed in bulk it becomes purple. The slime dissolves, and the liquid becomes a deep wine colour. Alcohol discharges the colour, and causes a cloudiness which, however, disappears on standing. If the liquid is neutralized with hydrochloric acid, the colour changes to yellow, and no cloudiness occurs when alcohol is added.

With chlor-zinc-iodide, both the slime and the cell-walls stain yellow-brown. Occasionally a small patch of the slime stains violet. After forty-eight hours in 10 per cent. caustic potash, the cell-walls stain violet, and the starch grains purple-brown to reddish-brown.

Neither the slime nor the cell-walls dissolve in copper-oxide-ammonia.

In strong chromic acid both the slime and the cells dissolve, with evolution of gas from the former. With fresh material, the cell walls are dissolved in about two hours, but after being soaked in water for forty-eight hours they dissolve in a few minutes.

There is no effervescence with hydrochloric acid, sulphuric acid, or acetic acid. Dilute hydrochloric acid induces a granular deposit in the cells which renders them opaque. No calcium crystals are formed with either hydrochloric or sulphuric acid, or with ammonium oxalate after heating with 2 per cent. hydrochloric acid.

With methylene blue, both the slime and the cells stain blue, not violet. Acetic acid does not destroy the colour. Alcohol discharges the colour very slowly: after an immersion of twenty-four hours in 80 per cent. alcohol, the cell-walls have lost all colour, but the slime remains green. Immersion for the same length of time in glycerine leaves both the slime and the cells pale blue.

Ruthenium red stains the cell-walls red, but does not stain the slime.

Alcoholic alkannin does not stain the slime or the cells after an immersion of eighteen hours.

With Sudan III in glycerine, numerous granules in the slime stain red, but the cell-walls and the general mass of the slime remain uncoloured. Immersion for twenty-four hours in dilute alcoholic Sudan III, transferring to glycerine, and heating, as recommended by Küster, only stains the granules as before.

No coloration is produced by phloroglucin.

Aniline blue stains the slime blue or greenish blue; eosin stains it red.

The coloration of the cell-walls in chlor-zinc-iodide, before and after treatment with caustic potash, and their insolubility in copper-oxide-

ammonia indicate that they are suberised. On the other hand, they dissolve in chromic acid, rapidly if previously soaked in water, and they do not stain with alkannin or Sudan III.

The coloration of the slime with methylene blue is not that of pectic compounds and it is not discharged by alcohol or glycerine. The slime does not stain with ruthenium red. It would appear that it is not a pectose slime.

A small amount of the slime stains blue with chlor-zinc-iodide, and is probably cellulose slime, but the main mass is not, as it stains yellow-brown with chlor-zinc-iodide and is insoluble in copper-oxide-ammonia.

The slime gives the reactions for callose in that it is insoluble in copper-oxide-ammonia, readily soluble in caustic potash, and stains, though scarcely typically, with aniline blue. But it also stains with eosin, which does not stain callose: and it does not dissolve in concentrated cold sulphuric acid.

Mocharas is rich in tannin. Ferric chloride produces a green coloration, potassium bichromate an intense red-brown, and ammonium molybdate yellow.

I regret that I am unable to institute any comparisons with the results of previous investigations of the slimes which occur in the Bombacaceae or Malvaceae, as no literature on the subject is at present accessible.

I have not been able to find any evidence that the formation of Mocharas is induced by the action of fungi or bacteria.

When recently exuded, Mocharas is usually quite free from bacteria, or fungus spores or hyphae. Pieces taken from the interior of the mass with the customary precautions showed no growth when placed in culture flasks in (a) water, (b) a solution containing 5 per cent. cane sugar and 1 per cent. asparagin, or (c) standard nutrient solution. Agar plates of (b) and (c) gave the same result.

Mocharas, according to the evidence obtained, is derived from an abnormal layer of cortical parenchyma which is formed in the stems of *Bombax malabaricum* after they have been felled, or in some instances, though apparently rarely, after the cortex has been injured. It consists of the remains of the walls of the cortical cells, which retain their continuity though much reduced in thickness, bound together by a slime.

HAEMATOMYCES.

Haematomyces spadiceus, B. and Br., is dried Mocharas. The supposed disorganized hyphae seen in a section are the walls of the collapsed and distorted cells, while the few cells which retain, more or less, their original oval shape constitute the 'obovate, vesicular asci'. The bodies which Berkeley and Broome considered spores are amyloid grains.

The genus *Haematomyces*, as originally described, consequently falls, for even if it should subsequently be demonstrated that Mocharas owes its origin to the action of a fungus, the exudation itself, which is the material on which the genus was founded, is not a fungus. The three species of *Haematomyces* since described bear no relation to the original species, if their descriptions can be relied upon.

The simplest way out of the difficulty which thus arises would appear to be that the generic description of *Haematomyces* should be amended in accordance with the ideas which have been associated with the name by Peck, Rick, and mycologists in general; and, though the writer is aware that he is venturing on very dangerous ground in classifying fungi from their descriptions only, the following is proposed:

Haematomyces (Char. emend.). Stroma superficial, pulvinate, often cerebriform or convoluted, tremelloid or fleshy-waxy, bearing a palisade layer of asci and paraphyses over the whole exposed surface, immarginate: spores continuous, hyaline.

The genus appears to be out of place in the Bulgarieae, and should probably be placed in the Helvellaceae. In many points it appears to be too close to *Psilopezia*, Berk.

The following new species has recently been collected in Ceylon:

Haematomyces carneus, n. sp. Pale purple-red to flesh colour, pulvinate, cerebriform, up to 1.5 cm. diameter, superficial, subtranslucent, tremelloid. Asci cylindric, $160 \times 10-12 \mu$, not operculate, eight-spored, spores obliquely uniseriate. Paraphyses stout, inflated at the apex, diffluent. Spores hyaline, oval, thick walled, ends subtruncate, $15-18 \times 8-9 \mu$, exceptionally $26 \times 10 \mu$. On dead wood, leaves, &c. Delwita, Ceylon, June 1918; No. 5767 in Herb. Peradeniya. The whole ascus stains blue with iodine, the spores and paraphyses staining yellow.

SUMMARY.

1. Mocharas is an exudation from wounded or, more commonly, felled *Bombax malabaricum*. It is formed from a special layer of cortical parenchyma, and consists of the remains of cortical cells united by a slime.

2. This substance was made the type of a new genus of fungi, *Haematomyces*, by Berkeley and Broome in 1873, the type species being named *Haematomyces spadiceus*.

3. As the substance is not a fungus, Berkeley and Broome's genus falls, but the name is here retained for those species which have been placed in the genus by subsequent authors.

4. A new species of *Haematomyces* is described.

LITERATURE.

1. BADEN-POWELL, B. H. : Mochras, an Exudation from the Bark of *Bombax malabaricum*. Indian Forester, vol. viii, 1882, pp. 153-5.
2. COOKE, M. C. : Report on the gums, resins, oleo-resins, and resinous products in the India Museum, or produced in India. London, 1874.
3. Dictionary of the Economic Products of India. Article Bombax.
4. DYMCK, W. The Vegetable Materia Medica of Western India. Bombay, n.d. (1883).

Petch, T. 1919. "Mocharas and the genus *Haematomyces*." *Annals of botany* 33, 405–419. <https://doi.org/10.1093/oxfordjournals.aob.a089729>.

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