CHROMOBLASTOMYCOSIS IN PUERTO RICO*

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FEW DERMATOSES have ever attracted more widespread interest than the one described during recent years as chromoblastomycosis. When the history and characteristics of this disease are carefully studied, the reasons for that interest become readily apparent. The clinical picture, with its numerous, prominent, cauliflower-like or verrucose growths is so spectacular, that the observation of a single case leaves an everlasting impression on the mind. The histopathology, furthermore, shows striking epidermal changes and, in the corium, a specific, tuberculoid reaction with characteristic, brownish, yeast-like bodies representing the causative agent. Etiologically, several species of fungi have been described. Finally, in well-developed cases, it has been impossible to eradicate the infection with any of the usual methods of therapy. All these features have contributed to make chromoblastomycosis a rather extraordinary disease.

The geographical distribution of the infection is not less remarkable. Since Medlar[1] and Lane[2] published their observations on the Boston case in 1915, which was the first to appear in the medical literature, at least 53 infections with chromoblastomycosis have been recognized in different countries, many of them a great distance apart. Although the disease is encountered in temperate climates, the majority of cases have occurred in the tropics. Up to the present time it is known to exist in Brazil,[3-18] Uruguay,[19] Paraguay,[20] Argentine,[21] Costa Rica,[22-25] Guatemala,[26] United States,[1, 27, 28] Puerto Rico,[29, 31] Cuba,[32, 33] Dominican Republic,[34] Algeria,[35] East Africa,[23] Russia,[36, 37] and Sumatra[38, 39]; and there is no doubt that, as medical men become better acquainted with its clinical picture, the realm of this mycosis will be found to extend over practically the whole world.

The first patient with chromoblastomycosis in Puerto Rico was discovered in 1931.[29] Since then, a total of seven cases has been registered. If the size and population of the various countries where the disease is now known to be prevalent should be related to the respective number

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of reported cases, Puerto Rico, with 3,435 square miles and a population of 1,728,534, would stand out as the most heavily infected region in the world. In earlier communications[29, 31] we have thoroughly discussed two of our seven patients (cases 1 and 4). In this paper we are presenting the remaining five, with brief summaries of the two already published.

CASE REPORTS

CASE 3.* *History.*—P. S., of Caguas, Puerto Rico, a white, agricultural laborer, about 40 years old, was referred to the University Hospital on November 27, 1933 (U. H. No. 1584).

The patient complained of a pruriginous eruption which had started eight years before as a small wart on the internal border of the left foot. The growth was scratched off, but soon recurred and began to spread peripherally. New lesions made their appearance on other parts of the foot and lower leg and, in the course of time, the eruption gradually extended up to the knee. When the infection was contracted the patient was working barefooted in a sugar cane plantation. There was no history of trauma of any sort at the site of the initial lesion. Although the general health had not been impaired, the skin condition had partially incapacitated the patient for work.

Examination.—Upon examination, the left lower extremity revealed a skin eruption extending from the sole of the foot up to a little below the patella (figs. 1 and 2). On the foot and lower third of the leg the eruption consisted of numerous, elevated, irregular, hard growths, some of them smooth and dull pink in color; others, warty and dirty gray; and still others, which were papillomatous and cauliflower-like in appearance. The size of the growths varied from that of a pea to much larger—coalescence of several lesions often resulting in the formation of rather extensive, irregular masses, more or less polycyclic in contour. By scratching the crusts that covered some of the lesions, a slight hemorrhage occurred which was readily and spontaneously inhibited.

In the upper two-thirds of the leg the eruption was more patchy in character. Here the lesions were more or less circular or oval in shape, varying roughly in size from three-fourths to four inches in main diameter. In their marginal zone, the patches showed considerable elevation above the surface of the healthy skin, they had a dull violaceous or pinkish color, and were sometimes papillomatous in character. The more extensive central zone was much shallower, had an irregular surface and was usually covered by dirty yellow, grayish or dark, adherent squamae or crusts, which, upon being removed gave rise to slight hemorrhages. Some of the patches showed complete healing in the center with an irregular distribution of the skin pigment over the scar. In the upper leg, as on the foot, the lesions were often confluent, the borders then becoming more irregular and polycyclic. Actual ulceration was not evident anywhere, but a characteristic foul odor from the lesions was perceptible for a distance. On the affected part of the extremity there was marked edema giving to the region an elephantiasic appearance. The nail plates, though

* Instead of describing the cases chronologically, it has been found convenient to present them in the following order: 3, 5, 6, 2, 7, 1 and 4.

fairly-well preserved, showed considerable thickening due to the formation of a spongy material underneath them.

Laboratory Data.—The urine was normal. A blood count gave the following results: erythrocytes—4,070,000; hemoglobin—70%; W.B.C.—10,550; small lymphocytes—21%; mononuclears—3%; polymorphonuclears—70%; eosinophiles—3%; basophiles—1%. The Kahn test was negative. The feces contained hookworm and whipworm ova.

Squamae from the lesions treated with potassium hydroxide solution (20%) and examined under the microscope revealed numerous, large, spherical, brownish, sometimes septate cells, as well as coarse, septate, branching filaments of the same color, often emerging from the cells (fig. 13). In cultures from the squamae and tissues a dark fungus was obtained, namely, *Hormodendrum pedrosoi.*

Histopathology.—The epidermal surface presented numerous depressions filled with keratinized débris. In these depressions there were completely keratinized epithelial pearls within some of which were included clumps of fungus cells and, in one or two points, a delicate brown mycelium arising from these cells. The stratum corneum was very much thickened and the rete mucosum showed marked hypertrophy with elongated epithelial columns extending deep into the corium. The basal layer of the epidermis was sharply defined. The corium was broadened and presented, in its superficial layers, numerous pseudo-tubercles consisting of epithelioid cells and giant cells, mostly of the Langhans type. In the center of the pseudo-tubercles there were clumps of polymorphonuclears as well as groups of rounded or crescent-shaped, brownish bodies limited by a dark, thick, refractile and apparently doubly contoured membrane. Surrounding the pseudo-tubercles there was a dense infiltration with lymphocytes, plasma cells, eosinophiles, a moderate number of polymorphonuclears and a few Russell's fuchsin bodies. Intermingled with these cells, and sometimes within the giant cells, were found many spherical fungus structures of the type described above. The infiltration was focal in certain areas. At the tip of the dermal papillae there were accumulations of round cells and also small, abscess-like collections of polymorphonuclear leukocytes. The remaining portions of the superficial dermal layer was composed of organizing granulation tissue rather rich in capillaries. Deeper down in the corium there was a dense fibrosis. In this zone the blood vessels were surrounded by foci of plasma cells with a few lymphocytes and eosinophiles. This part of the section also showed numerous deposits of hemosiderin pigment often arranged in clumps along the bundles of collagenous fibrous tissue. The sweat glands and some of the hair follicles were atrophic.

Case 5. *History.*—R. G., a white, married farmer, aged 50 years, residing in Utuado, Puerto Rico, was admitted to the University Hospital (U. H. No. 2222) on April 16, 1935. He complained of "tumors" of the right leg and foot.

The patient had been in good health up to about six years before admission, when a small pinkish nodule appeared on the dorsum of the right foot near the ulnar border, there being no history of previous trauma at the site of the lesion. At that time he used to work barefooted in a plantation where beans, sweet potatoes and *yautías* were raised. The nodule increased slowly in size until it formed a violaceous, flattened out tumor covering an area nearly 2 inches in diameter. Soon after, new lesions appeared in the neighboring regions and, in the course of time, the eruption

gradually spread up to the lower part of the knee. During the two years preceding admission the patient had been suffering from recurrent attacks of fever with pain, redness and swelling of the affected leg.

Examination.—The well-developed lesions appeared as large, markedly prominent, hard, lobulated, most of them papillomatous, tumor masses arising at various points of the skin of leg and foot, which had undergone a moderate degree of elephantiasis (fig. 3). Some of the lesions were sessile, while others, particularly those on the foot, had enormously overgrown their bases and had become pedunculated. Their surface was often smooth, pink and shiny as that of a ripe tomato, but most frequently it was papillomatous, fungating, cauliflower-like in appearance and covered, here and there, by more or less adherent, grayish scales, and dirty, dark crusts. A certain amount of ulceration had occurred in some of the growths, the raw surfaces being covered with adherent yellowish membranes. Although coalescence was observed in some places, a good number of isolated lesions had grown to a very large size, giving to the clinical picture, in this patient, a very striking appearance. The infected leg emitted a very offensive odor. Subjectively, itching had been the only troublesome symptom.

Laboratory Data.—The blood was examined on April 9, 1935 with the following result: erythrocytes, 3,890,000; hemoglobin, 82%; W.B.C., 7,800; small and large lymphocytes, 30%; mononuclears, 1%; polynuclear neutrophiles, 67%; eosinophiles, 2%. The Kahn test (4/16/35) was negative.

The urine did not show important changes. The feces revealed whipworm ova and cysts of *Endamoeba coli.*

Scrapings from the surface of the lesions, treated with potassium hydroxide and examined under the microscope, revealed numerous, spherical, thick-walled, yellowish brown cells, measuring about 12 microns in diameter, arranged either singly or in groups, many of them showing an intracellular septum. Coarse, thick-walled, septate filaments of the same color of the cells and emerging from them were also noted. Cultures from this material produced a dark fungus having the characteristics of *Hormodendrum pedrosoi.*

Histopathology.—A microscopical description of the lesions was reported by the pathologist as follows:

> "The malpighian layer of the epidermis is broadened throughout the whole section, but particularly at the center. The elongated rete pegs are sharply defined against the subjacent corium. The stratum corneum is only slightly thickened. The corium is distinctly broadened and fibrotic. It shows a diffuse infiltration with round cells which form large dense foci in the superficial portions. Here and there are ill-defined tubercle-like groupings of epithelioid cells without any caseation and with only occasional giant cells. Phagocytic cells and Russell's acid-fuchsin bodies are frequently observed and also a few eosinophiles."

Large, spherical, thick-walled, brownish fungus cells, isolated or in groups, were often noted, both within the giant cells and free in the infiltrate.

CASE 6. *History.*—J. C., of Gurabo, Puerto Rico, a white, married farmer, 55 years old, was examined at the dispensary on June 1 and admitted to the University Hospital (U. H. No. 2345) on July 15, 1935.*

* On the day of admission to the hospital the patient had chills, high fever and pulmonary symptoms which developed into a pneumonia. The attack followed a comparatively mild course with complete recovery within a short period.

The chief complaint consisted of large, intensely pruriginous, verrucose growths on the right foot. The eruption had started about 10 years before while the patient worked barefooted in a farm where tubers and cereal (corn, beans and pigeon peas) were raised. The initial lesion was a warty efflorescence on the dorsal aspect of the big toe, without any history of previous trauma at the site. This efflorescence slowly increased in size and, after three years, new lesions of the same nature started to develop on the dorsum of the foot and toes. Subsequently the disease continued to spread insidiously but steadily over the adjacent regions.

The patient had been in good health until the onset of the present illness. About three years after the outbreak of the skin condition he began to suffer from recurrent episodes of pain, redness and swelling of the foot and leg, accompanied by chills and high fever, lasting 4 or 5 days. During the first attacks the swelling would usually subside with the rest of the symptoms, but, after some time, the affected regions did not regress to a completely normal state, the parts remaining a little more swollen after each recurrence.

Examination.—at the time of examination, the eruption extended over the anterior half of the dorsum, ulnar border and sole of the right foot, including the toes, with a single, small, isolated lesion located farther up on the anterior portion of the lower leg (fig. 12). The clinical picture was fundamentally the same as that of the preceding cases. The foot as a whole revealed a certain degree of elephantiasis. There were a number of more or less infiltrated, often confluent, foul-smelling patches or tumors of different sizes, some of them elevated 5 or 6 millimeters above the normal skin. They were dull reddish or violaceous in color. Their surface was irregular, dry, scaly, papillomatous and often warty in appearance. Some of the nails were thickened, spongy underneath, and had a yellowish white color.

Laboratory Findings.—A blood examination on June 1 revealed: hemoglobin, 86%; R.B.C., 3,990,000; W.B.C., 6,900; polymorphonuclears, 70%; lymphocytes, 21%; mononuclears, 2%; eosinophiles, 7%. The Kahn test was negative (June 29, 1935). The urine showed no important changes. The feces contained hookworm ova (July 16). Microscopic examination of the scales from the lesions treated with potassium hydroxide (20% solution), revealed numerous, round, olivaceous cells, both isolated and in groups. Filamentous, septate structures bearing the same color were also in evidence.

Histopathology.—Microscopically, the epidermis showed marked hyperkeratosis and a pronounced hypertrophy of the malpighian layer, particularly in the center of the section, with irregular strands of epithelium extending downward for a short distance. The cells did not, however, assume a neoplastic character. Immediately beneath the epithelium, the connective tissue contained an inflammatory exudate consisting of small capillaries and numerous cells. This exudate was somewhat irregular in distribution being more intense and diffiuse in the center of the section and more focal toward the periphery. The cellular infiltrate consisted chiefly of mononuclear cells of various types, including many plasma cells, polymorphonuclear neutrophiles and occasional eosinophiles. Some of the plasma cells had Russell's bodies in their cytoplasm. The polymorphonuclears were mainly confined to the tissue immediately beneath the surface but the lymphoid and plasma cells accompanied the vessels into the deeper connective tissue for a short distance. Some of the sections revealed the presence of pseudo-tubercles with giant cells of the Langhans type, epithelioid cells and, in some instances, accumulations of leukocytes in the center. In the inflammatory tissue near the surface, as well as in the leukocytic

accumulations in the pseudo-tubercles, could be seen a number of spherical, yellowish brown, yeast-like bodies, a little larger than a plasma cell. In the Gram stain these bodies were slightly positive.

CASE 2. *History.*—The history and clinical data concerning this patient are incomplete as we were away on vacation at the time of admission. The diagnosis was made through a biopsy by Dr. E. Koppisch who happened to see the patient on his first visit, but was unable to locate him afterwards.

The patient, A. I., was a white, male Puerto Rican, 80 years old, residing in Coamo. He complained of an old, large, fungating lesion on the lower third of one of the legs. When examined by the local physician, the pathologic process covered an area about 3.5 inches in diameter. There were no subjective symptoms.

Biopsy Report.—"Gross: The specimens consist of several, variously sized and shaped tissue fragments, similar to one another in gross appearance. The largest measures 2 x 1 x 0.5 cm. Superficially, all the pieces show numerous, pale yellow to dark grayish nodules which vary in size from 0.2 to 0.4 cm. The tissues are crumbly. Sections through the largest specimen reveal surfaces studded with minute, pale grayish areas within a background of pale gray and translucent tissue. The elongated dermal papillae may be seen at the margin of the cut surface.

Microscopic: The lesion is characterized by extremely marked thickening of the stratum corneum (fig. 6). The epidermis as a whole is broadened and sends irregularly sized and shaped pegs into the corium (fig. 4). In some places the corium is quite dense and fibrosed. In others, it is loose, edematous and infiltrated by groups of plasma cells. In still others, there are tubercle-like structures made up of epithelioid cells and occasional giant cells of the Langhans variety (figs. 7, 8 and 9). Some of the tubercles are infiltrated by polymorphonuclear leukocytes in the center. At this point a few of them also show brownish, spherical bodies, about 15 microns in diameter, with a thick lining membrane and clear or granular contents, some of them showing internal septation (figs. 7, 8 and 9)."

Diagnosis.—The chronic, fungating character of the lesion, its location and long duration, the characteristic histopathology, the presence of typical fungus cells in the tissues, and the residence of the patient in a district where the disease is not uncommon led us to the conclusion that this was an authentic case of chromoblastomycosis.

CASE 7. *History.*—In this instance, as in case 2, the diagnosis was made through a biopsy by Dr. E. Koppisch, of the Department of Pathology. The material came from an amputated leg (Dec. 18, 1935) and was sent by the local physician, Dr. M. Zapata, in Coamo, a distant town. The clinical picture as observed by Dr. Zapata was as follows:

The patient, P. S., was a widower, 60 years old, a white farmer, living in Barrio Guayabal of Juana Díaz, where he had contracted the disease twenty years before amputation. The infection had started as a scaly, pruriginous growth on the heel without any previous trauma as far as could be remembered. After the first year, new lesions of the same type started appearing on the dorsal aspect of the foot and finally over the whole leg. The subjective symptoms had been very slight and there had been no general disturbances.

When the infection began the patient was engaged in cutting down trees in the woods. His general health at the time of examination was satisfactory. The past

history was negative and, in the family history, there was nothing of particular importance.

Clinically, the lesions were described as prominent, fungating tumors of different sizes and shapes, most of them isolated one from the other. There was no actual ulceration, nor free suppuration.

Histopathologic Report.—"Gross: The specimen consists of two pieces of skin measuring, respectively, 2.5 x 1.8 cm. and 3.5 x 3 cm. in principal diameters. The epidermal surface is nodular in places and papillary in others, and is covered by thin keratinized lamellae. Section shows the epidermis to be thickened; it forms papillary folds between which there is an abundance of pultaceous yellowish débris. The corium is much broadened and pinkish.

Microscopic: There is much folding of the epidermis (fig. 5). The horny layer is enormously thickened, and the depressions between the papillary folds are filled with parakeratotic or completely keratinized epithelium, occasional clumps of bacteria and dense collections of fragmented leukocytes. The malpighian layer is for the most part broadened, but in places is distinctly thinned out. The rete pegs are greatly elongated and often broadened. The basal cell layer is very vaguely defined in many areas, but the morphologic characters of the epidermal cells are unaltered. The papillary zone of the derma is broadened and composed of slightly edematous connective tissue, rich in capillary blood vessels. This zone presents diffuse and focal infiltration (fig. 5) with plasma cells, lymphocytes and a few eosinophiles. The infiltration tends to be more pronounced immediately beneath the epidermis, where there are, in addition, occasional, very minute abscesses. The epidermis adjacent to the abscesses is often infiltrated by polymorphonuclear leukocytes and, in a few places, it also shows microscopic abscesses (fig. 10). At different levels of the papillary zone, but most frequently at a short distance from the epidermis, there are numerous pseudo-tubercles (fig. 11) composed of irregularly arranged epitheloid cells and one or two giant cells of the Langhans type. Giant cells are also seen unaccompanied by epithelioid cells. In one section there is a fairly large abscess in the superficial portions of the derma, and its walls, throughout part of the circumference, are composed of a barrier of radially arranged epithelioid cells. The spherical or dumb-bell shaped, brown, sclerotic cells of the fungus are usually found within giant cells, but also occur in the center of micro-abscesses, and free in the tissues (figs. 10 and 11). The reticular layer of the corium is only partially included in the sections. The collagenous bundles of this layer are very irregularly arranged and often seem swollen. There are large dense collections of lymphocytes, plasma cells and a few large mononuclears, but fungus cells and pseudo-tubercles are not encountered in this layer. No sweat or sebaceous glands, and no hair follicles are seen. The adventitia of small arteries is much broadened. The lymphatic channels of the papillary portion of the derma are dilated."

CASE 1 (Abstract).* *History.*—J. R., a white, agricultural laborer, of San Sebastián, Puerto Rico, aged 50 years, was admitted to the University Hospital on June 27, 1931 (U. H. No. 414). The chief complaint was a chronic, pruriginous, foul-smelling skin eruption affecting the left lower extremity. General health fairly well preserved.

The disease had started about 15 years prior to admission as a verrucose papule

* A more detailed discussion of this case was presented in a previous publication.[20]

on the dorsal aspect of the second toe. This lesion increased in size and, after some time, similar efflorescences began to appear higher up on the foot. The infection continued to progress insidiously but steadily and, in the course of years, the leg, the knee, and lower part of the thigh were successively invaded.

Examination.—The clinical picture was polymorphous in character. On the foot, some lesions were hard, irregular and warty in structure. On the leg and, partially on the foot, the eruption consisted of large, prominent, irregular, papillomatous masses, many of them having a cauliflower-like appearance. Farther up on the extremity the lesions were less infiltrated, less prominent and more patchy in character.

Lesions of unquestionable metastatic nature were observed at two points. In the lower third of the left forearm (ulnar side) there was a hard, lumpy mass covering an area 3 x 1½ inches, deeply situated in the subcutaneous tissue, the skin covering the region showing no sign of infection whatsoever. On the anterior middle third of the right thigh there was a deeply seated nodule about the size of a large bean, lying within a pocket in the muscle just beneath the fibrous sheath of the *rectus femoris*. The skin and other tissues covering this lesion were also perfectly healthy. The mycotic nature of these two metastases was established by the histopathology and cultural findings.

Laboratory Data.—The histopathologic changes were fundamentally similar to those noted in the preceding cases. Cultures from the lesions revealed the presence of a grayish black fungus, the morphology of which was consistent with that described in Brazilian cases of chromoblastomycosis.

COMMENT ON CASE 1.—The patient whose history has just been abstracted, represents the first case of chromoblastomycosis recognized in Puerto Rico.[29] From the clinical point of view, it was remarkable, not only for the extent of the eruption, but also for the number and extraordinary development of the lesions. The presence of unquestionable metastatic foci in this patient was considered an extremely significant fact, since lesions of this type had never been noted before in chromoblastomycosis and the possibility of their occurrence has a very important bearing on the prognosis of the disease.

CASE 4 (Abstract).* *History.*—M. G., a white, married, agricultural laborer, of Toa Alta, Puerto Rico, 50 years old, was admitted to the University Hospital on September 11, 1934 (U. H. No. 1968). He complained of a chronic, pruriginous skin eruption of the left upper extremity.

The disease had started about 28 years prior to his admission as a small pimple on the anterior aspect of the wrist. The lesion persisted obstinately, extending peripherally year by year until it had involved most of the hand, the forearm, elbow and lower arm. The general health had not been affected.

Examination.—Upon examination the hand and fingers showed marked deformity due to scarring and a certain degree of elephantiasis. A large portion of the extremity was covered with a chronic, dry, dull-red or violaceous, scaly, somewhat psoriasiform dermatitis which extended to the inferior third of the arm, where it

* A full discussion of this case was given in a previous publication.[31]

was limited by well-demarcated, irregular and polycyclic borders. The infected skin was thickened and elevated one to two millimeters above the surface of the surrounding integument. On the hand, wrist and finger tips some patches had become slightly papillomatous and showed ulcerated points here and there. Extensive, diffuse, superficial scarring with irregular distribution of the skin pigment was noted over a large part of the forearm and hand. The nails were thick and spongy underneath.

Laboratory Findings.—The histopathologic changes were indistinguishable from those observed in other cases of chromoblastomycosis. Scales from the lesions revealed the presence of spherical, olivaceous, fungus cells. In laboratory cultures, the causative agent developed as a Hormodendrum, which resembled, in some respects, *H. pedrosoi,* but which showed many clean-cut differences, clearly separating it from that species. Consequently, the new fungus has been described as *Hormodendrum compactum,* Nov. Sp.[30, 31]

COMMENT ON CASE 4.—The patient studied in the above abstract presents what appears to be a new clinical type of chromoblastomycosis.[30, 31] The disease did not show either the nodules or the large, prominent, vegetative tumors usually present in this mycosis, the lesions being more patchy, less infiltrated and, only in places, more or less papillomatous. The propagation of the infection to neighboring regions apparently took place by peripheral extension of the original focus, rather than by the frequent production of satellite lesions, which is the rule in other cases of chromoblastomycosis. The correct diagnosis was based on the isolation, from the lesions, of a fungus somewhat resembling *Hormodendrum pedrosoi,* as well as on the histopathology which was typical of chromoblastomycosis. Etiologically, this case is also remarkable because it has added a new species of fungus to the list of causative agents for this disease (see "Mycologic Study" below).

MYCOLOGIC STUDY

We were unable to get material for cultures in cases 2 and 7. In the rest of the patients it was not difficult to isolate the causative fungus from either the infected tissues or the epidermal débris obtained by scraping the lesions superficially. After isolation, the macroscopical characters of the organisms were studied in plate cultures on Sabouraud's proof medium[40] and on 4 per cent dextrose agar poured to a depth of about 7 mm. The morphology was determined through microscopical observation of slide cultures on corn meal and Czapek's solution agars. These cultures were first flooded with several drops of 80 per cent alcohol, then drained by lifting slowly one end of the slide, and finally flooded again with 10 per cent potassium hydroxide solution, after which a cover slip was carefully laid over the growth. The technique

was carried out with great caution to avoid, as far as possible, the disintegration of the spore heads.

In addition to the five strains obtained from Puerto Rican patients, a comparative study of 13 others, isolated from cases in different countries, was carried out. These included three specimens of *Phialophora verrucosa,*[41, 27, 44] the so-called *Hormodendrum algeriensis,*[35] the organism described by Moore and Almeida under the name *Phialoconidiophora guggenheimia,*[42, 43] one from North Carolina,[28] a strain labeled "*Trichosporium pedrosoi* (Brumpt) Langeron," obtained from the C.B.S., in Baarn, Holland, one from the Dominican Republic[34] and five others from Brazil. Of these five Brazilian strains, three were kindly sent to us by O. da Fonseca, who isolated them from recent cases of chromoblastomycosis. The remaining two were obtained through the courtesy of Dr. F. Weidman, of Philadelphia, in 1932.

In four of our local strains, the morphology was generally consistent with *Hormodendrum pedrosoi,* the most frequent etiologic species in chromoblastomycosis. The other Puerto Rican strain has been described as a new species, namely, *Hormodendrum compactum.*[30, 31] Although the type of sporulation characteristic of *Phialophora verrucosa* was occasionally encountered in all of the five strains above mentioned, conidiophores of that type were never sufficiently abundant to warrant the inclusion of any of these strains in the genus Phialophora.

HORMODENDRUM PEDROSOI.—Plate cultures 4 weeks old developed at room temperature (25° C.) on Sabouraud's *milieu d'epreuve* (fig. 14) were circular in contour with a diameter of about 5.5 cm. In the center there was a hemispherical, or irregularly convex prominence having a maximum elevation of approximately 8 mm. above the surface of the medium, and covering an area from 0.5 to 1 cm. across, or even larger. From this central prominence, the colonies sloped down gently toward a shallow marginal zone. When viewed in profile, they had the shape of a flattened cone, some of the specimens having a folded appearance due to the presence of radial furrows. The surface was covered with a felt-like network made up of short, delicate, ascending, olivaceous gray, aerial hyphae. By scratching this superficial growth with the inoculating needle, a more compact and consistent, somewhat elastic, charcoal-black, membranous structure was exposed.

On 4 per cent dextrose agar, the growth was fundamentally similar to that observed on *milieu d'épreuve,* but there was a more profuse and less uniform development of aerial hyphae which rendered some of the colonies more uneven superficially. In this medium the color of the thallus was mouse gray, the olivaceous tone being less pronounced.

Microscopically, the cultures consisted of a network of erect or ascending aerial hyphae. These hyphae (fig. 15) followed an irregularly straight or undulant course, showed septa at varying intervals, branched profusely at open angles, were olivaceous in color and measured from 1.25 to 3 microns in diameter. The cytoplasm of each of the articles between the septa was granular in appearance and contained one or more refractile droplets of diverse size and morphology, usually spherical or oval. The cell walls were thick and dark.

Conidiophores and conidia were produced in abundance from superficial hyphae at any point of the thallus. Three different types of sporulation have been constantly found by us in every single strain of this species studied. Two of them, the *Hormodendrum* and the pseudo-*Acrotheca* types, are highly predominant in frequency over the third, namely, the *Phialophora* type. As a rule, spore heads of the former two types developed terminally on branches of varying lengths (figs. 16 and 20) but a certain number of these heads was always found to arise from small protuberances on the sides of the hyphae (fig. 24). In mature cultures, the articles on which the spores were borne, or even the whole fertile branch, would often present a deeper pigmentation than the vegetative structures (figs. 19 and 20).

The *Hormodendrum* sporulation was represented by clusters of smooth, generally ovoid, thick-walled, olivaceous conidia which were developed in branching chains at the tip of the conidiophore (figs. 16, 17 and 18). Each conidium was produced by a budding process at the distal pole of the element immediately preceding it, so that the terminal cell of the series was always the youngest (fig. 19). Branching resulted from the development of more than one bud in the same cell. Each particular conidium was loosely united to its immediate neighbors in the chain through small thickenings of the cell walls at their points of contact. The resulting interconidial joints, so-called disjunctors, were not usually as conspicuous in *Hormodendrum pedrosoi* as in many saprophytic species of the same genus (figs. 16, 18 and 23).

In well-developed *Hormodendrum* heads, the conidia varied in size and shape according to their relative position in the chains. The basal elements, those arising directly from the conidiophore, measured 2.5 to 3.5 by 7 to 10 microns, exceptionally reaching a length of 13 microns, or even more. In optical section, each of these elements resembled an elongated shield having, on its distal extremity, a number of tiny, prominent, truncate nodules on which the secondary conidia were inserted (figs. 16 and 17). On the proximal end, there was only one of these nodules which bound the spore to a corresponding small protuberance

at the tip of the conidiophore. The secondary, and sometimes even the tertiary conidia, were somewhat similar in morphology to the basal elements above described, although their size was not as large. The conidia forming the terminal portion of the chains, which represented the great bulk of the head, were more uniform in size and oval in shape. They measured from 3 to 5 microns in length by 1.5 to 3 microns in width.

In the pseudo-*Acrotheca* type of sporulation the conidia were produced acropleurogenously on the terminal, occasionally also the subterminal, article of the fertile branch (figs. 20, 21, 22 and 23). Their morphology and size corresponded with the oval forms above described in the *Hormodendrum* chains, each individual conidium being borne on a small nodular prominence on the surface of the conidiophore. When the spores remained single (not catenate), as was often the case (figs. 20 and 21), the fertile hypha with its terminal cluster offered a close resemblance to the sporulating branches characteristic of *Acrotheca*. However, under optimum conditions of growth, the original spores revealed a definite tendency to develop chains of *Hormodendrum* type (figs. 22 and 23), thus separating our organism from the genus *Acrotheca*. The combination of *Acrotheca*-like bunches and typical chains of pure *Hormodendrum* type in the same head was not an uncommon feature in cultures of *H. pedrosoi*.

The *Phialophora* type of sporulation, which occurs only sparsely in *H. pedrosoi*, was observed without much difficulty in slide cultures on Czapek's solution agar after the second week of growth. The conidiophore was a flask-shaped structure consisting of a single, often inflated, cell having on its distal extremity a narrow constriction or neck, which opened into a cup-like receptacle (figs. 25 and 26). It measured from 6 to 12 microns in length by 2 to 3 in width. The conidia were budded out individually and successively from the constricted portion of the conidiophore into its adjacent cup (figs. 26 and 27). They were delicate, unicellular, oval structures, measuring 1.5 to 2 by 2 to 3 microns, with a pale green, finely granular protoplasm and a thin, smooth, hyaline cell membrane. Although set free as soon as produced, these conidia would tend to agglutinate temporarily at the mouth of the cup, due to the presence of a mucilaginous substance which was apparently liberated during the process of sporulation (fig. 28). This agglutinating tendency, however, was not as marked as in the species *Phialophora verrucosa*.

The single-celled conidiophores occurred as lateral branches (see fig. 27) or as the terminal element of a fertile hypha (see figs. 25 and 26). Not infrequently a sporogenous neck with its cup was developed, without the usual inflated basal portion, on the side of a hyphal article.

In such cases this article became a part of the conidiophore (see fig. 28).

The *Phialophora* and *Hormodendrum* types of sporulation would sometimes occur in close association, both forms being observed side by side in the same hyphal element. This association became most remarkable when one or several of the spores of a typical *Hormodendrum* head were transformed into fructifying *Phialophora* conidiophores, thus combining the two methods of sporulation in one and the same conidial head (see fig. 29).

Under unfavorable conditions of growth, large, spherical or oval chlamydospores were often developed. In addition, old cultures showed a scant, or even moderate, number of spherical, thick-walled, deeply pigmented, often septate cells, measuring 8 to 12 microns in diameter (fig. 30). These, so-called "sclerotic cells," were frequently produced in groups at the tip of, or laterally on, a hyphal element, and resembled the parasitic structures observed in tissues infected with chromoblastomycosis.

HORMODENDRUM COMPACTUM.[30, 31]—Well-developed plate cultures of *H. compactum* on Sabouraud's proof medium (fig. 31) and 4 per cent dextrose agar (fig. 32) resembled *H. pedrosoi* in their flattened conical shape and dark color, but there were certain features that helped to distinguish between the two species. In *H. compactum* the rate of growth was much slower. Cultures of this fungus and of *H. pedrosoi* growing under the same conditions compared diametrically in a proportion of 1 to 3 or even 1 to 4. Mature colonies of *H. compactum* (6 weeks) were irregular and uneven in their surface, the aerial hyphae were coarser, forming characteristic tufts, and the border was usually indented. These characters were in contrast with those of *H. pedrosoi,* where the growth was more regular and smooth, the aerial mycelium formed a felt-like network on the surface of the culture and the border was more regularly circular. Microscopically, the differences were just as marked. In *H. compactum* the hyphae were coarser, the cell walls thicker and more irregular in outline, and the protoplasm of the cells more deeply pigmented and with more numerous and larger droplets (fig. 34). Branching occurred at sharper angles and, occasionally, dichotomous bifurcation of the hyphal tips was encountered, a feature that has never been observed in cultures of *H. pedrosoi.*

The pseudo-*Acrotheca* type of sporulation did not occur in *H. compactum.* On the other hand, *Phialophora* conidiophores, essentially similar to those of *H. pedrosoi,* were always produced in small numbers (fig. 38). In the *Hormodendrum* heads of *H. compactum,* the spores were spherical or sub-spherical, they were wider than those of *H.*

pedrosoi and there were no disjunctors, the elements being compactly linked together in the chains by broad articular facets which rendered dissociation of the spores very difficult (figs. 35, 36 and 37). As in *H. pedrosoi,* the *Hormodendrum* and *Phialophora* types of sporulation were occasionally associated in the same spore head (figs. 39 and 40).

Finally, the chlamydospores and "sclerotic cells" (fig. 41) mentioned in the description of *H. pedrosoi* were also found in *H. compactum.*

SUMMARY AND COMMENT

Since the presence of chromoblastomycosis was first revealed in Puerto Rico in 1931,[29] a total of seven patients suffering from that comparatively rare fungus infection has been encountered in this small island. In six of these patients the clinical manifestations and the histopathology were generally consistent with chromoblastomycosis as described in Brazil and elsewhere. In one of them, case 4, the histopathology was identical with that of the others, but the skin lesions presented many peculiar, clinical features that are different from the usual type of the disease, and the causative fungus was found to be a new species which has been named *Hormodendrum compactum.*[30, 31]

The development of unquestionable metastatic foci in case 1 is considered an extremely significant fact, since lesions of this nature had never been noted before in chromoblastomycosis and the possibility of their occurrence has a very important bearing on the prognosis of the disease.

On the basis of a careful cultural study of various strains of fungi isolated from cases of chromoblastomycosis in different countries, Emmons and the writer, working in collaboration in Puerto Rico, have shown: (a) that, for the present time, the name *Hormodendrum pedrosoi* Brumpt 1922[50] is most adequate to designate the species commonly etiologic in tropical countries;[45] (b) that there is a close relationship among the different fungi which cause the disease, namely, *Hormodendrum pedrosoi, Phialophora verrucosa* and *Hormodendrum compactum.** Evidence of this relationship was advanced in September

* In addition to these three species there are four others which have been associated with single, isolated cases of chromoblastomycosis. Moore and Almeida[48] claim that one of the fungi studied by Pedroso and Gómez[4] in 1920 is a new species which they have named *Phialophora macrospora.* The fungus isolated by Rotter and Peña Chavarría from one of their Costa Rican cases, was classed by C. W. Dodge as *Hormodendrum langeroni.*[35] Finally, Y. Takahashi has recently described *Torula poikilospora,* n. sp.,[52] and *Hormodendron japonicum,* n. sp.,[53] which were isolated, respectively, from two cases of chromoblastomycosis in the Far East. So far, we have been unable to obtain cultures of the above strains for a comparative study.

1935[46, 47] when it was discovered, in our laboratories, that the type of sporulation characteristic of *Phialophora verrucosa* is constantly, though sparsely, encountered in the two species of *Hormodendrum,* a finding which Conant and Martin[48, 28] have corroborated in most of the strains they have observed.

In June 1936,[42] and later in the same year,[43] Moore and Almeida described a fungus isolated from a recent case of chromoblastomycosis in São Paulo, where they claim to have found sporulation types of four different genera, namely, *Phialophora, Acrotheca, Botrytis* and *Hormodendrum.* Accordingly, they have proposed the name *Phialoconidiophora guggenheimia* to designate this strain, which would represent a new species and a new genus.

After a careful study of the above organism carried out by Emmons and the writer, however, we were unable to determine any fundamental difference whatsoever between the so-called *P. guggenheimia* and other specimens of *Hormodendrum pedrosoi* in our collection. In Moore and Almeida's strain, the predominant type of sporulation is that of *Hormodendrum.* The presence of additional conidiophores of *Phialophora* and of spore clusters resembling *Acrotheca* only confirms that the fungus is identical with *Hormodendrum pedrosoi.* With respect to the *Botrytis* type of sporulation mentioned by these investigators, it should be remembered that adverse conditions of growth, or even cultural variation in a given organism, may affect the development and arrangement of the spores, giving rise to abnormal forms that would be suggestive of other species. In *H. pedrosoi* where morphological deviations of this type are not uncommon, a hasty examination might bring to mind such genera as *Acrotheca, Botrytis, Trichosporium* and perhaps others, none of which, however, represent the predominating, normal characteristics of the fungus. When carefully examined under optimal conditions of growth, it is quite evident that Moore and Almeida's organism is simply another strain of *H. pedrosoi.*

In the same year (1936), Negroni,[49] of Buenos Aires, published an excellent paper on the fungus isolated from what appears to be the first authentic case of chromoblastomycosis recognized in Argentina. The clinical aspects of this case were discussed in an earlier publication by Baliña *et al.*[21] The description and drawings presented by Negroni are consistent with *H. pedrosoi,* except that no mention is made of the *Phialophora* type of sporulation. This investigator does not place the fungus in either *Hormodendrum* or *Acrotheca* on the grounds that each of these two genera possesses only a single method of sporula-

tion. Accordingly, he has created the new genus *Fonsecaea* to include all the strains of *H. pedrosoi,* proposing a tenth synonym for the fungus of tropical chromoblastomycosis, namely, *Fonsecaea pedrosoi.*

The persistent tendency noted during the last few years to extend the synonymy of *H. pedrosoi* Brumpt 1922[50] is to be greatly regretted, as it is promoting increasing complication in this field. It must be admitted that there are certain conflicting features in the morphology of this organism that might lead to confusion with respect to its botanical position. However, to many investigators who have given time and thought to this subject, the original name given by Brumpt[50] seems quite satisfactory and, for the sake of convenience, this name should be preserved, at least for the present. After all, we are dealing with the imperfect form of a fungus and there is no justification for complicating the nomenclature with a long list of names while we are still ignorant of a definitive sexual phase in the life history of the organism. As Dodge has suggested,[51] there is a possibility that the anomalous *Phialophora* spores observed in laboratory cultures of this *Hormodendrum,* are not true conidia, but spermatia. Should this be the case, it is to be hoped that an ascomycetous phase will soon be demonstrated for this species, its botanical position becoming, thereby, automatically and permanently established. In the meantime, unless something actually fundamental can be offered to justify a change, any addition to the synonymy of *H. pedrosoi* should be considered superfluous and undesirable.

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PLATE I

Fig. 1 (Case 3). Chromoblastomycosis of left lower extremity showing lesions of the verrucose type and many elevated, irregular, papillomatous growths.

Fig. 2 (Case 3). Inner aspect of leg.

Fig. 3 (Case 5). The lesions appeared as large, markedly prominent, hard, lobulated, most of them papillomatous, tumor masses arising at various points of the skin of leg and foot.

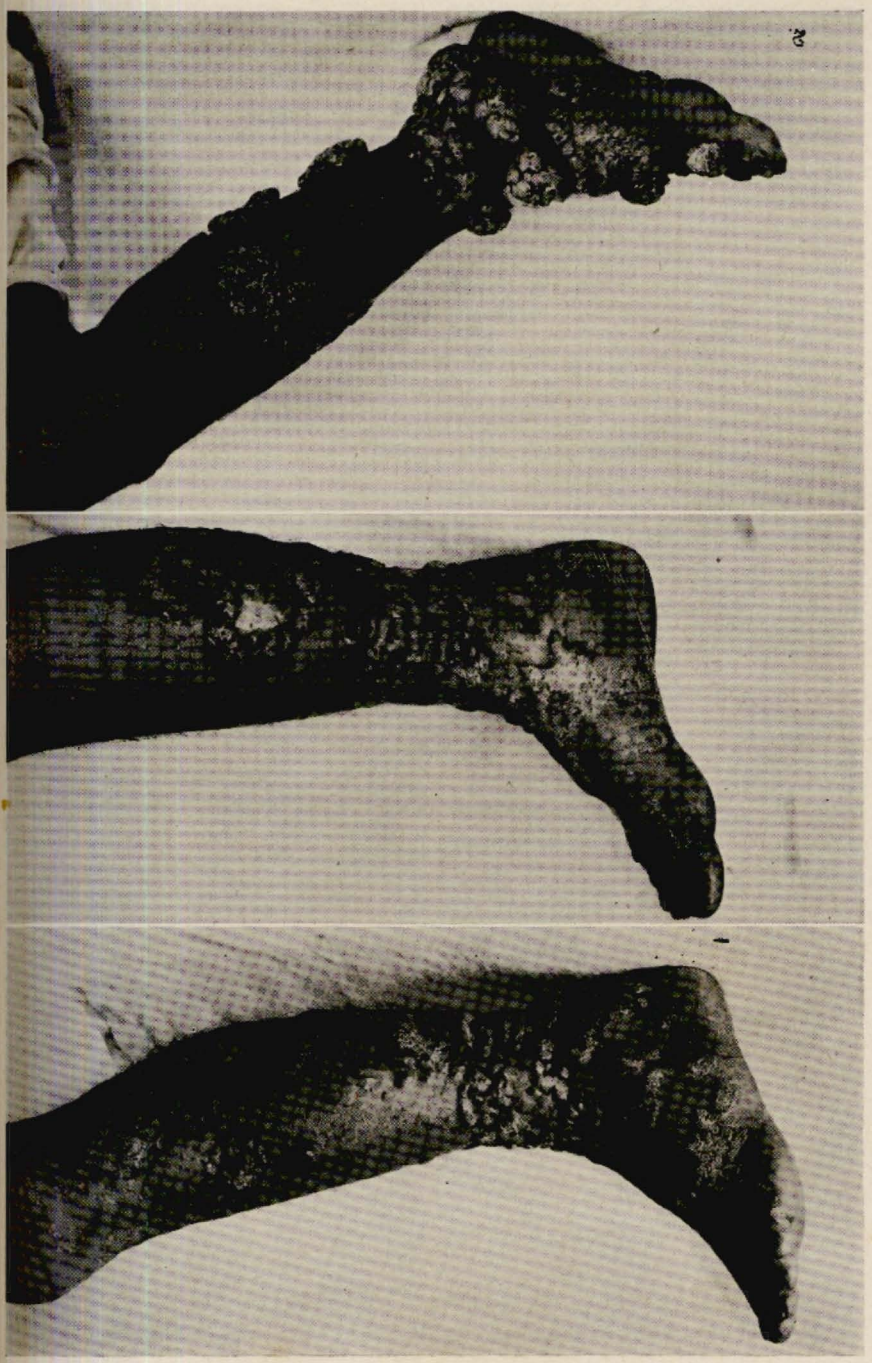
PIES PARA LOS GRABADOS

Grabado 1 (Caso 3).—Lesiones cromoblastomicósicas del miembro inferior izquierdo, de tipo verrucoso, con muchas excrescencias irregulares y papilomatosas.

Grabado 2 (Caso 3).—Parte interna de la pierna.

Grabado 3 (Caso 5).—Las lesiones tienen el aspecto de masas tumorales grandes, muy prominentes, duras, lobuladas, la mayoría papilomatosas, que se levantan en distintos parajes de la piel del pie y de la pierna.

PLATE I



1 2 3

PLATE II

Fig. 4 (Case 2). Section of skin. The broadened epidermis sends irregularly sized and shaped pegs into the corium. The latter is infiltrated with groups of plasma cells and shows tubercle-like structures made up of epithelioid cells and occasional giant cells of the Langhans variety (x 100).

Fig. 5 (Case 7). Section of skin showing folding of epidermis and proliferation of the malpighian layer. The upper corium presents diffuse and focal infiltration with plasma cells, lymphocytes and a few eosinophiles, as well as pseudo-tubercles (x 100).

Fig. 6 (Case 2). Section of skin showing marked thickening of stratum corneum with typical fungus cells (x 400).

Fig. 7 (Case 2). Skin section showing a tubercle-like structure with a fungus cell (x 400).

Grabado 4 (Caso 2).—Corte de una lesión de la piel. De la epidermis engrosada parten columnas epiteliales, de distintos tamaños y de forma irregular, extendiéndose hasta el corium. Este aparece infiltrado por acúmulos de células plasmáticas, conteniendo masas tuberculoideas formadas por células epitelioides y algunas células gigantes de Langhan (x 100).

Grabado 5 (Caso 7).—Corte de la piel en que se observan los pliegues de la epidermis y la proliferación del cuerpo de Malpigio. La parte superior del corium muestra infiltración difusa y focal con células plasmáticas, linfocitos y algunos eosinófilos, además de los seudotubérculos (x 100).

Grabado 6 (Caso 2).—Corte de la piel mostrando gran engrosamiento del estrato córneo con células fungosas típicas (x 400).

Grabado 7 (Caso 2).—Corte de la piel donde se ven seudotubérculos con células fungosas (x 400).

PLATE II

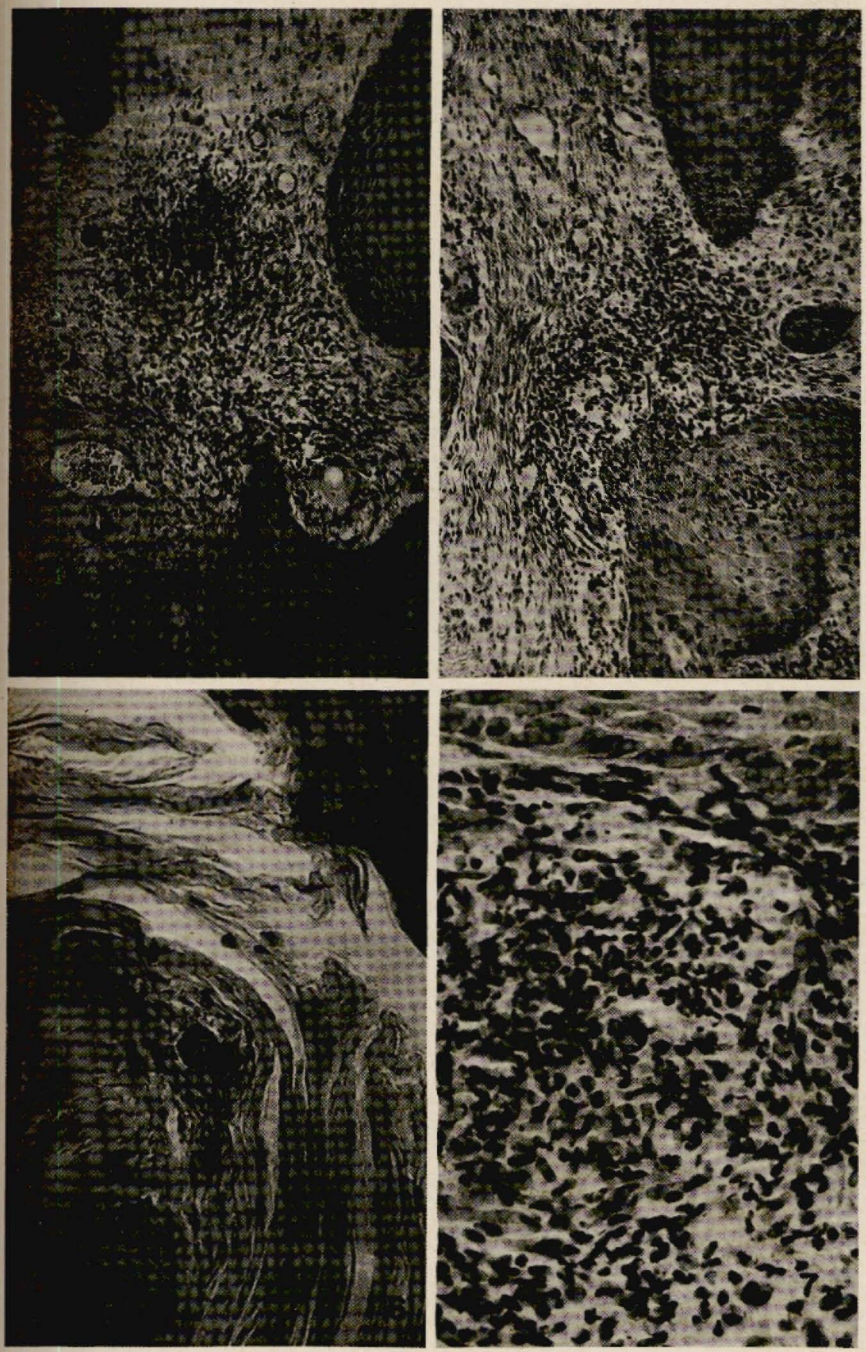


PLATE III

Fig. 8 (Case 2). Skin section with pseudo-tubercle. Note fungus elements within giant cell (x 460).

Fig. 9 (Case 2). Skin section with pseudo-tubercle and group of fungus cells.

Fig. 10 (Case 7). Skin section. Microscopic intra-epidermal abscess showing fungus structures, one of them within a giant cell (x 400).

Fig. 11 (Case 7). Skin section showing sub-epidermal pseudo-tubercle with epithelioid and giant cells as well as the fungus (x 400).

Grabado 8 (Caso 2).—Corte de la piel con seudotubérculos. Nótese al parásito dentro de una célula gigante (x 460).

Grabado 9 (Caso 2).—Corte de la piel con seudotubérculos y grupo de células fungosas.

Grabado 10 (Caso 7).—Corte mostrando un absceso microscópico intraepidérmico con elementos parasitarios; uno de los parásitos, dentro de una célula gigante (x 400).

Grabado 11 (Caso 7).—Corte mostrando un seudotubérculo subepidérmico con células gigantes y epitelioides además del hongo (x 400).

PLATE III

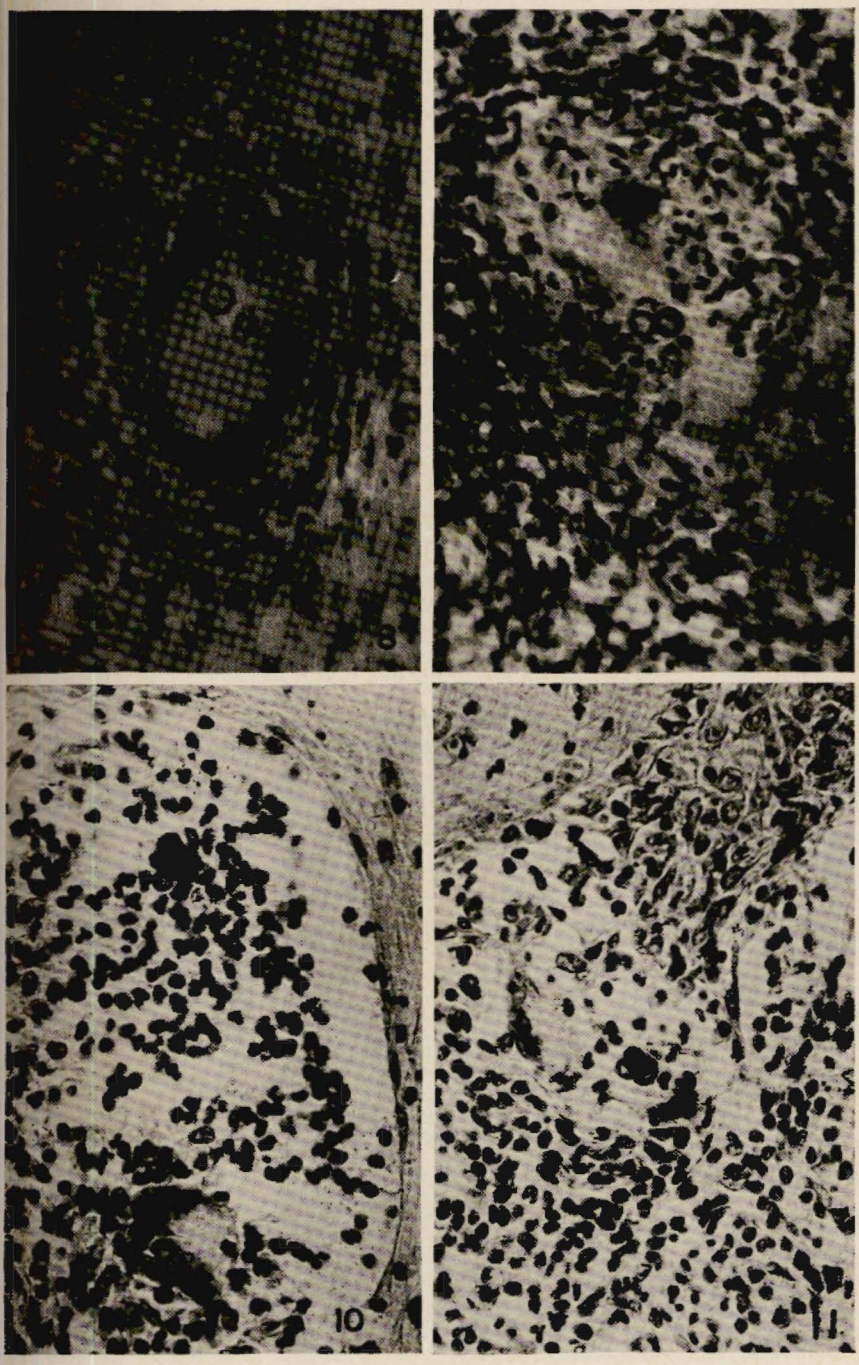


PLATE IV

Fig. 12 (Case 6). The foot showed numerous, infiltrated, often confluent patches or prominent tumors of various sizes. The surface of the lesions was irregular, dry, scaly, papillomatous and often warty in appearance.

Fig. 13 (Case 3). Scales from lesions showing large, spherical, sometimes septate cells as well as coarse, septate, branching filaments emerging from the cells (x 400).

Fig. 14. Culture of a strain of *Hormodendrum pedrosoi* (case 6) on Sabouraud's *milieu d'épreuve* at the end of the fourth week.

Grabado 12 (Caso 6).—Lesión del pie donde aparecen numerosas placas epiteliales, infiltradas, frecuentemente confluentes, y tumores prominentes de distintos tamaños. La superficie de las lesiones es irregular, seca, escamosa, papilomatosa, y frecuentemente de aspecto verrucoso.

Grabado 13 (Caso 3).—Escamas de las lesiones donde se observan grandes células esféricas, septadas a veces, y también gruesos filamentos septados y ramificados que emergen de las células (x 400).

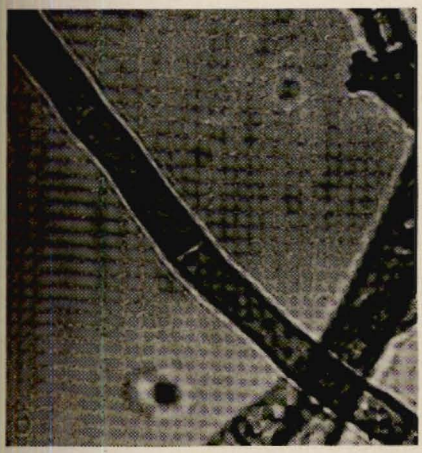
Grabado 14.—Cultivo de una raza de *Hormodendrum pedrosoi* (procedencia: caso 6) en medio de prueba de Sabouraud, al final de la cuarta semana.

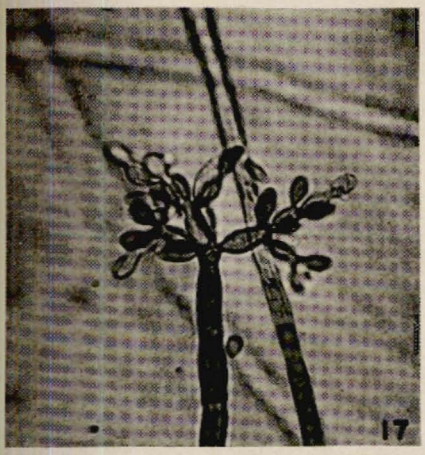
PLATE V

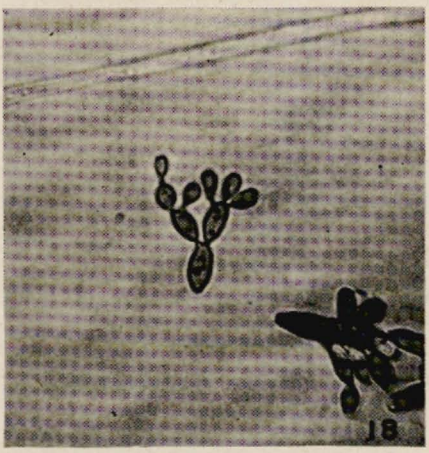
Figs. 15 to 20. *Hormodendrum pedrosoi:* in figure 15, well-developed hyphae on Sabouraud's *milieu d'épreuve* (x 2,250); in figure 16, a conidiophore with spore head of *Hormodendrum* type on corn meal agar (x 1,000); in figure 17, a spore head of *Hormodendrum* type on corn meal agar (x 1,000); in figure 18, segment of a spore head of *Hormodendrum* type on corn meal agar (x 1,000); in figure 19, conidiophore and young *Hormodendrum* head (x 900); in figure 20, conidiophore of *Acrotheca type*—note pigmentation of conidiophore (x 900).

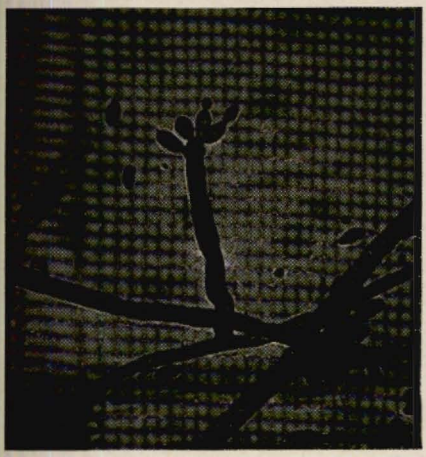
Grabados 15-20.—Hormodendrum pedrosoi. En el grabado 15, vense hifas bien desarrolladas, crecidas en medio de Sabouraud (x 2250); en el 16, un conidióforo con cabeza esporular de tipo *Hormodendrum,* en medio de cultivo de agar-maíz (x 1000); en el 17, una cabeza esporular de tipo *Hormodendrum* en agar-maíz (x 1000); en el 18, segmento de una cabeza de esporos, tipo *Hormodendrum,* en agar-maíz (x 1000); en el 19, conidióforo y cabeza esporular joven, tipo *Hormodendrum* (x 900); en el 20, conidióforo de tipo *Acrotheca* (nótese la pigmentación del conidióforo) (x 900).

PLATE V









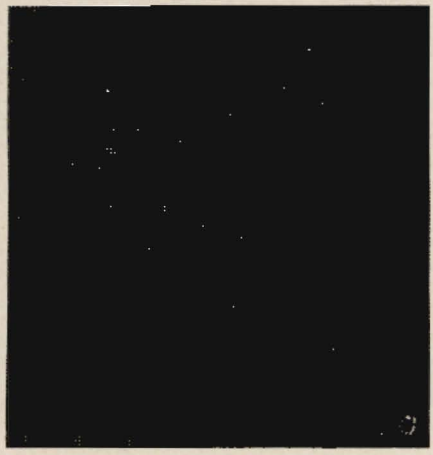
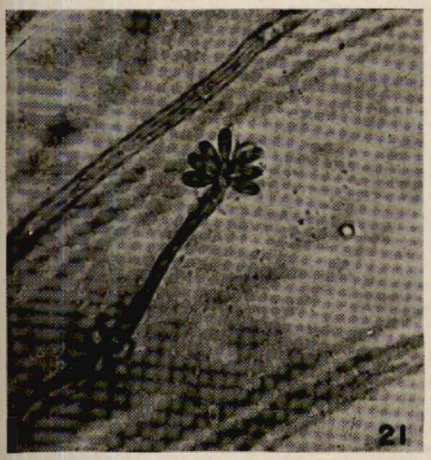


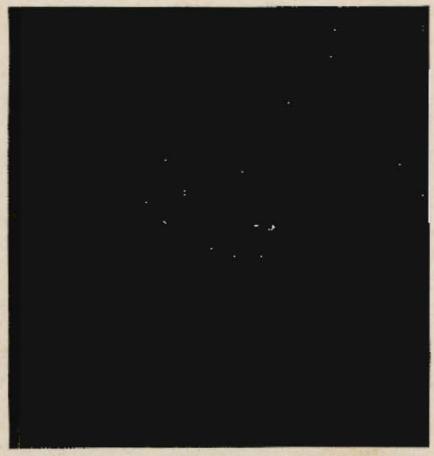
PLATE VI

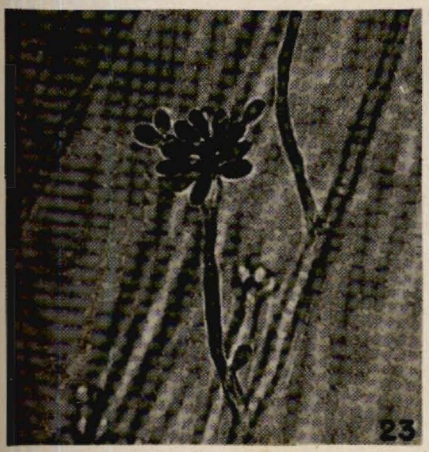
Figs. 21 to 26. *H. pedrosoi:* in figure 21, conidiophore with *Acrotheca*-like cluster (x 1,000); in figure 22, conidiophore and spore head of pseudo-*Acrotheca* type showing chain formation (x 1,000); in figure 23, conidiophore and spore head of pseudo-*Acrotheca* type—note tendency to form branching chains (x 1,000); in figure 24, young spore head developed from a small protuberance on side of hypha (x 900); in figure 25, terminal conidiophores and conidia of *Phialophora* type (x 1,000); in figure 26, terminal conidiophore of *Phialophora* type—note budding conidium within cup (x 1,000).

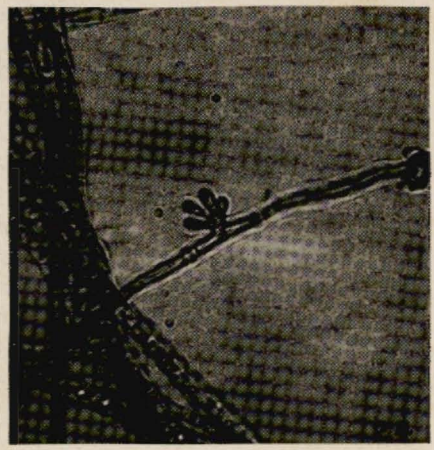
Grabados 21-26.—H. pedrosoi. En el grabado 21 puede observarse un conidióforo con ramillete semejante a los de *Acrotheca* (x 1000); en el 22, conidióforo y cabeza esporular de tipo seudo-*Acrotheca* formando cadena (x 1000); en el 23, cabeza esporular semejante a la del Núm. 22, donde se nota la tendencia a formar cadenetas ramificadas (x 1000); en el 24, cabeza de esporo joven brotando de una pequeña proturberancia lateral de la hifa (x 1000); en el 25, conidióforo terminal y conidios de tipo *Phialophora* (x 1000); en el 26, conidióforo terminal de tipo *Phialophora;* puede observarse el conidio brotando dentro del brocal (x 1000).

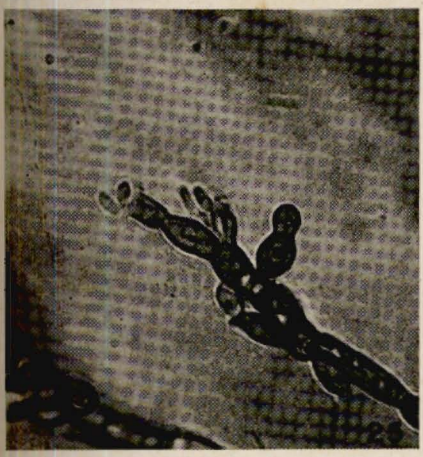
PLATE VI











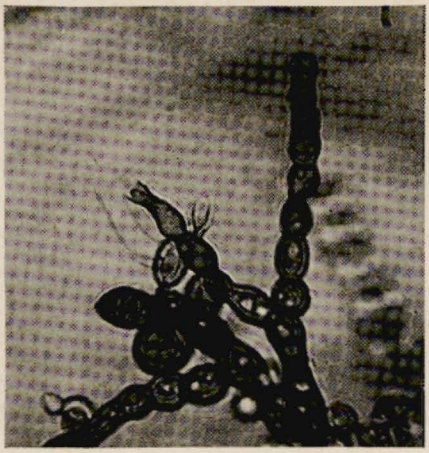


PLATE VII

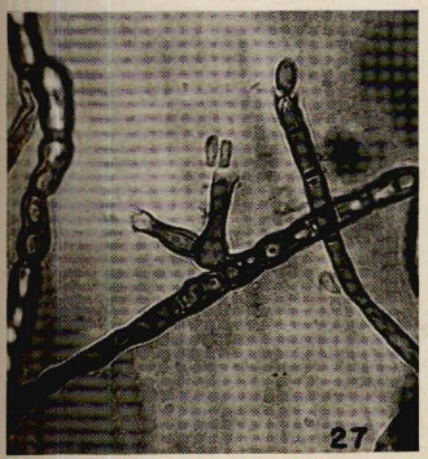
Figs. 27 to 30. *H. pedrosoi:* in figure 27, lateral coniodiophores and conidia of *Phialophora* type (x 1,000); in figure 28, lateral conidiophore with group of agglutinated conidia of *Phialophora* type, a hyphal article representing basal portion of conidiophore (x 1,000); in figure 29, a spore head of *Hormodendrum* type where one of the elements has given rise to a sporulating cup and conidia of the *Phialophora* type (x 900); in figure 30, terminal, septate, "sclerotic cell" (x 1,000).

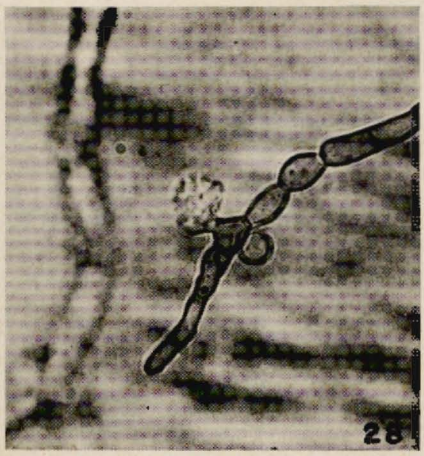
Figs. 31 and 32. *H. compactum:* Cultures six weeks old on Sabouraud's *milieu d'épreuve* and 4 per cent dextrose agar respectively.

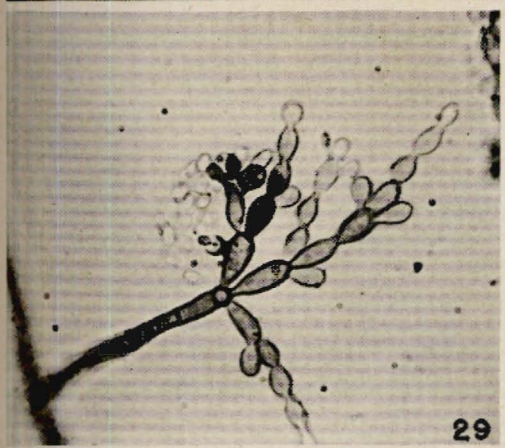
Grabados 27-30.—H. pedrosoi. En el grabado 27 conidióforos laterales y conidios de tipo *Phialophora* (x 1000); en el 28, conidióforo lateral de tipo *Phialophora* con un ramillete de conidios aglutinados; el artículo que le da origen constituye, a la vez, la base del conidióforo (x 1000); en el 29, cabeza esporular de tipo hormodéndrico donde uno de los elementos se ha transformado en una copa esporular con conidios de tipo *Phialophora* (x 900); en el 30, "célula esclerótica" septada y terminal (x 1000).

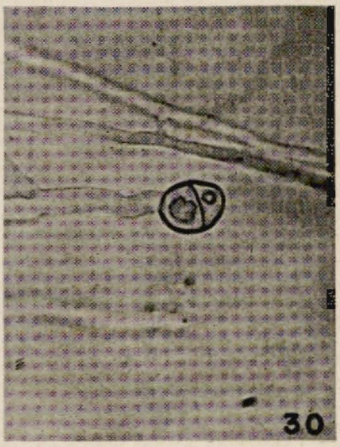
Grabados 31 y 32.—H. compactum. Cultivos de seis semanas, en Sabouraud y en agar dextrosado al 4 por ciento, respectivamente.

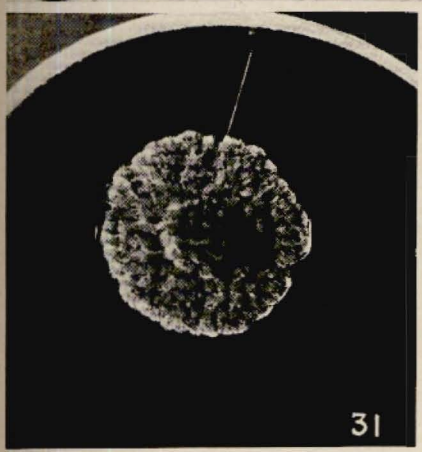
PLATE VII











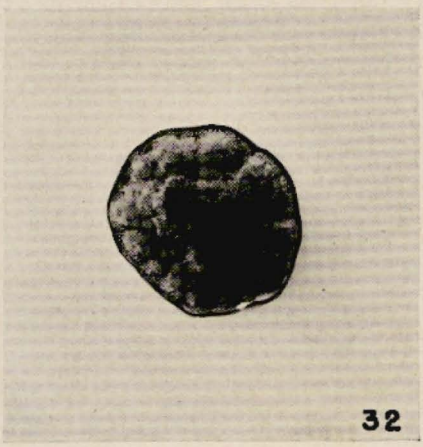


PLATE VIII

Figs. 33 to 41. *H. compactum:* in figure 33, group of fungus cells in scale from lesions (x 600); in figure 34, hyphal structures (x 2,250); in figure 35, conidiophores with spore heads (x 700); in figure 36, young spore head of *Hormodendrum* type (x 1,000); in figure 37, fully developed spore head of *Hormodendrum* type (x 1,000); in figure 38, terminal conidiophores and conidia of the *Phialophora* type (x 1,000); in figure 39, well-developed spore head of *Hormodendrum* type with two of its elements transformed into cups of the *Phialophora* type—note numerous spores (out of focus) produced by these cups (x 1,000); in figure 40, hyphal tip bearing small *Hormodendrum* head (right) and a typical *Phialophora* conidiophore with spores (left) (x 1,000); in figure 41, group of "sclerotic cells" (x 1,000).

Grabados 33-41.—H. compactum. En el grabado 33 vese un grupo de células fungosas en una escama obtenida de las lesiones (x 600); en el 34, estructura de las hifas (x 2250); en el 35, conidióforos con cabezas esporulares (x 700); en el 36, cabeza esporular joven de tipo *Hormodendrum* (x 1000); en el 37, cabeza esporular, tipo *Hormodendrum,* bien desarrollada (x 1000); en el 38, conidióforos terminales y conidios de tipo *Phialophora* (x 1000); en el 39, cabeza esporular hormodéndrica bien desarrollada, con dos elementos transformados en copas de tipo *Phialophora.* Nótense los numerosos esporos (fuera de foco) que han brotado de los cálices (x 1000); en el 40, punta de una hifa coronada por una pequeña cabeza esporular hormodéndrica (a la derecha) y un conidióforo típico de *Phialophora* con sus esporos (a la izquierda) (x 1000); en el grabado 41, obsérvase grupo de células escleróticas (x 1000).

PLATE VIII