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Soil Fungi from
North-East and North Brazil-VII

by

H. P. UPADYAY



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Soil Fungi from North-East and North Brazil - VIII¹, 2)

The Genus *Gongronella*

By H. P. UPADYAY³⁾

With plates 7 (1) - 9 (3)

The genus *Gongronella* was erected by RIBALDI (1952) to accommodate a single species, *G. urceolifera*, who believed that this species belong to the family Mortierellaceae. The main basis for his creating the genus is the presence of an apophysis and reduced size of columella. Later PEYRONEL and DAL VESCO (1955) and PICI (1955) correctly transferred *Absidia butleri* LENDER to the genus *Gongronella* mainly on the basis of the presence of well marked apophysis, and both of them pointed out that the type species *G. urceolifera* RIBALDI is identical to *G. butleri*. HESSELTINE and ELLIS (1961) added one more species, *G. lacrispora*, to this genus which was isolated from dooryard soil at National Institute of Health, Maryland. They differentiated this species *G. butleri* due to sporangia borne circinately on brittle sporangiophores and tear drop shaped sporangiospores.

HESSELTINE and ELLIS (1964) studied *G. butleri* (LEND.) PEYRONEL and DAL VESCO isolated from various sources in several parts of the world, and also other identical cultures to this species those identities were referred to the different genera by the prior workers. After a critical study of all these cultures they described more clear and noteworthy characters of *Gongronella* based on its two species, and made proper combinations of different identical fungi in *G. butleri*. Recently CHALABUDA (1967) combined *G. butleri* in *Mortierella* as *M. butleri* (LEND.) CHALABUDA which can not be correct because *G. butleri* has the following

¹) The title of "Soil Fungi from North-East Brazil" is replaced by "Soil Fungi from North-East and North Brazil" since the study is extended to the other regions in North of Brazil. The change is made from sixth serie of this paper.

²) Publication n° 631, IMUFFe.

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characters: (1) relatively slower growth of colonies (2) the formation of stolons (3) the presence of globose, hemispherical or urn shaped apophysis (4) the formation of reduced size columellae (5) blunt spiny or roughened zygospores, *Mucor* like, which are not at all like those found in the genus *Mortierella*.

No doubt some characters are intermediate between the genus *Gongronella* and *Mortierella* but they are distinct in one way or another. Some species of *Mortierella* leave the collar at the base of a small columella like globose apex of the sporangiophores as has been described by MEHROTRA and MEHROTRA (1964) in *M. sterilis* just as seen in primary stage of *G. butleri* (Pl. 3, Figs. 4, 5, 6, 7) but these collars never form columella while *G. butleri* do form small columella. Also, subsporangial vesicle formation is common in *M. vesiculosa* MEHROTRA, BAIJAL and MEHROTRA (1963, EMBREE 1963) but its formation is not well defined in this species and can not be taken as an important character while apophysis formation in both species of *Gongronella* is one of noteworthy character for the genus. Now naked zygospores formation is known in *Mortierella* LINNEMANN (GAMS and WILLIAMS 1963) and *M. marbugensis* LINNEMANN (WILLIAMS, GRAY and PAMELA HITCHEN 1965) but they are quite different from *G. butleri*'s rough and *Mucor* like. Thus these characters easily separate *Gongronella* from *Mortierella*.

Judging from the characteristics possessed by *Gongronella* one is forced to conclude that it represents a form intermediate between the Mucoraceae and the Mortierellaceae. From a practical point of view the asexual stage of Mucorales is more important than the sexual stage in determining natural relationship because most fungi belonging to Mucorales are common as heterothallic. Also, it is true that most families of Mucorales are distinguished according their asexual stages even some of them possess their sexual stages alike, for eg., Cunninghamellaceae forms zygospores *Mucor* like. On the other hand the zygospores of *Phycomyces* are not alike as of *Mucor* or family Mucoraceae. However, if we accept the precedent existing in the Mucorales for placing greater emphasis on asexual than sexual structure for delimitation of the families, even then we have to retain this genus in the family Mucoraceae because of short columellae formation along with zygosporic characters. Possessing these two characters no one can force to conclude that this genus belongs in the family Mortierellaceae.

HESSELTINE and ELLIS (1964) identified a fungus, isolated from a case of chronic in Uruguay, in which oftenly sporangia lacked columellae, but detail study of this fungus, however, disclosed the presence of sporangia with columellae in some cases. Therefore, they referred its

identity to *Mucor ramosissimus* SAMUTSEVITSCH. It would be also interested to point out that *Gongronella* differs from *Mucor* in the formation of well defined apophysis, especially.

Method and Material

The soil samples were collected from the fields of sugar cane and paddy cultivation of forest soil at the depth of 5–20 cm., at different times of the year where Instituto de Micologia of Universidade Federal de Pernambuco has under taken a soil microbiological survey with a colabration of SUDNE. All fungi determinations were made by soil dilution following the method of WARCUP (1950), but with some little modification and addition of xiteracyline (50 mg. per 100 ml.) to facilitate the separation of fungi from Actinomycetales and Bacteria. The method was well apropiate since relative large number of samples were to be processed and examined for the fungal population.

Fungi were isolated by dilution plate method, and then selected colonies were transferred in the culture tubes. The present fungi's description is based on Synthetic Mucor Agar as reported by HESSELTINE (1954). Also they are grown on potato-dextrose-agar, carrot-agar, Sabouraud-agar, Czapek's-agar and malt-agar. All media contain 5.5–6.5 pH.

GONGRONELLA RIBALDI in Riv. Biol. Gen. N.S. 44: 157–166, 1952.

Zygomycotina, Mucorales, Mucoraceae.

(HESSELTINE and ELLIS describe this genus as follows.)

Mycelium hyaline or slightly coloured, much branched, forming relatively slow growing colonies, with stolons and rhizoids poorly developed; sporangiophores erect or circinate, branched, septate. Sporangia small, deliquescing or breaking; columellae small or reduced in size; apophysis globose in shape and conspicuous but never giving the sporangium a pyriform shape; zygospores borne aerially, *Mucor* like, brown to black in colour, suspensors devoid of appendages, borne between parallel or non-parallel suspensors.

Type species:— *G. butleri* (LEND.) PEYRONEL and DAL VESCO.

GONGRONELLA BUTLERI (LENDNER) PEYRONEL and DAL VESCO, in Allionia 2: 370, 1955. HESSELTINE and ELLIS, in Mycologia 56: 371–375, 1964.

= *Mortierella butleri* (LEND.) CHALABUDA, in Novitates Systematicae Plantarum non Vascularium, pp. 163–172, 1967.

Colonies slow growing at room temperature (26°c) attaining a diam. of 2–4.8 cm. in 12 days, at first white, later olive-buff or pale olive-gray

in the center and finally gray in age; colonies reverse pale to pale-olive or pale olive-buff, later deep olive-buff in one month; odour none or very slight sweet. Sporangiphores $2.5-6\mu$ in diam. of variable length, arising from stolons or substrate mycelium, hyaline, smooth, slightly roughened in age, septate, branching irregularly or simply; sporangiphores arising from stolons are single or with single branch, bearing sporangia in an upright fashion; sporangiphores arising from substrate mycelium are multibranching, lateral branches occasionally rebranched, multispore-bearing; sometimes intercalary sterile sporangia are formed (Pl. 3, Figs. 2, 3), generally these sterile sporangia are simply intercalary and may form several on sporangiphores, may or may not form a sporangium at the top. For these intercalary sterile sporangia I presumed as vesicular cells of sporangiphores as are common in *Absidia* species but they form like sporangial vesicle (Pl. 3, Figs. 2, 3); occasionally sterile sporangium takes proliferation (Pl. 3, Fig. 1). Stolons $2-6\mu$ in diam., generally aseptate, colourless, smooth, thin-walled; rhizoids $1.5-6\mu$ in diam., smooth, branched generally at the bottom, thin-walled, nonseptate, arising from a swollen portion of the stolon, hyaline. Sporangia $7-22-28\mu$ in diam. (average $9-18\mu$), hyaline to yellow-tinted or faintly grayish-olive in reflected light, globose, multispored; sporangial wall transparent, thin and smooth, rarely roughened; columellae $3-6.8-8\mu$ in diam., hemispherical or dome-shaped, thin-walled, hyaline, smooth, with typically distinct collar mostly in young cultures; it is shielded by sporangiospores in old cultures. Apophysis hemispherical or urn shaped, hyaline, smooth, thin-walled, $4-9.5\mu$ in diam. Sporangiospores oval to flattened on one side or almost reniform, occasionally subglobose, allantoid, thin-walled, smooth, hyaline, $1.5-6 \times 1.5-2.5\mu$. Chlamyospores $4-8.5\mu$ in diam., borne on substrate mycelium, solitary and terminal, generally globose, less commonly irregularly oval, smooth, thick-walled, hyaline; zygosporangia $22.5-45(-52)\mu$ in diam., globose, compressed, between suspensors, at first brown, later becoming dark-brown to almost black in age, roughened, scattered from near the agar surface to the top of the colony, formed between adjacent; spines of zygosporangia stellate, blunt, occasionally recurved, $3-5.5\mu$ in length; large suspensors roughened, unequal, parallel, or non-parallel, abruptly swollen near zygosporangia, olivaceous, brown to dark-brown in age; heterothallic.

15 isolates of this fungus were isolated the mixture of two mating types of *Gongronella*, (+) and (-). They produced the zygosporangia on many investigated media with asexual fruitings in the same colony and thus this fungus was believed at first to be an homothallic species of *Gongronella*. Further monosporic and monosporangic cultural study of

this fungus, however, disclosed the absence of zygospores in all these cultures, one of the monosporic culture was crossed with (+) and (—) strains of *G. butleri* (LEND) PEYRONEL and DAL VESCO and this culture gave positive result with (—) strain of *G. butleri*. I am now convinced that these isolates are not homothallic, but they are mixture of the two mating types of *G. butleri*.

In many isolates intercalary sterile sporangia are formed simply or in chain with subsporangial swellings in the sporangiophore which may or may not form a sporangium at the end of sporangiophore. Occasionally proliferation takes place from the end sporangium, but this character has not been seen in the cultures which are repeatedly subcultured. Perhaps this characteristic was also pointed out by HESSELTINE and ELLIS (1964) as one encounter swelling in the aerial mycelium of some strains as if sporangia had been initiated and then the sporangiophore had been again initiated growth. Sporulation first occurs in the terminal sporangium, and then branches of the sporangiophore differentiate their sporangia. The septum under the sporangium forms after the spores have been produced. However, these cultures mate easily with apposite strain of *G. butleri* in various combinations. Therefore the identity of this fungus is referred to *G. butleri* (LEND.) PEYRONEL and DAL VESCO.

G. butleri is isolated one of the most common from the soil of paddy and sugar cane cultivation or forest at the depth of 5–20 cm. from all regions of North-East and North of Brazil. We have studied more than 200 isolates of this species since 1965 and so far.

The description given above was prepared from studies on Synthetic Mucor agar and potato-dextrose-agar at 26°C at 9 days old culture. The stolons and rhizoids description is based on carrot-agar since they were clearly seen and abundantly borne on this medium.

The fungus was also grown on Sabouraud-agar and Yeast-extract-agar where the growth was as luxuriant as on P.D.A., S.M.A. and carrot-agar. On all above media abundant zygospores were produced by those mixed strains of (+) and (—). While on Czapek's-agar growth is poor and zygospores either were not produced or very few. On malt-agar the fungus growth is none or very thin and zygospore were not seen.

Numerous reports indicate that this species is apparently worldwide in distribution and have been isolated from soil, roots of coconut, Brazil nuts, cot fabric and banana roots. However, mostly it is common in soil or the material that has been in contact with soil. This reports constitutes the first record of this species for Brazilian soil.

GONGRONELLA LACRISPORA HESSELTINE & ELLIS,
in Mycologia 53: 411, 1961.

Colonies grow slowly on Synthetic Mucor Agar at 26°c attaining a diam. of 4-5 cm. in 15 days, thickly floccose to felty, margin irregular, white at first, later becoming pallid neutral gray or pale-olive-gray, light vinaceous-fawn and vinaceous-buff toward the center of colony and drab-gray in 35 days; colonies reverse pale-olive-buff to deep-olive-buff in 35 days, wrinkled and furrowed both radially and circularly. Odour none or very slight. Sporangiphores 4-6.5 μ in diam., of variable length, arising from substrate mycelium, circinate or erect, oftenly smooth, occasionally slightly roughened in high magnification, generally non-septate, rarely septate, multisporeangiate, with the larger sporangia below, bearing one sporangium at a place, often terminated by a sterile filament, branched; branches arising in the upper portion of the main sporangiphore, bearing sporangia circinate to circularly, branches bearing sporangia constricted below apophyses; they are measured commonly 30-57 μ in length and 3-4.5 μ in weadth, sometimes they are up to 87 μ long and 5 μ in diam.; often with septa in upper region of the curvature. Rhizoids and stolons are not seen in any medium. Sporangia 12-40.5 μ in diam., globose, at first white, then grayish-olive and in age with a yellow to tan tint in reflected light, multispored, always borne circinate with an apophysis, sometimes abortive sporangia present in old cultures; sporangial wall smooth, thin, transparent, fragile; apophysis 3.5-9 μ in diam., hemisphaerical, hyaline, smooth; columellae are clearly seen in young cultures and they are shieled by sporangiospores in old cultures; they are dorsiventrally flattened to sphaerical, smooth-walled, hyaline, generally constricted at attachment to apophysis, 5-16 \times 3-9 μ . Sporangiospores 5-9 \times 3-4.5 μ , lacrimoid to narrowly napiform, hyaline, light yellow-brown in mass, thick-walled especially at the tapered end, smooth. Chlamydospores borne in substrate mycelium, usually simple and terminal, mostly globose, rarely oval, smooth, contents granular and vacuolate, hyaline, 8-12 μ in diam. Zygosporés absent; heterothallic (Pl. 3, Figs. 14-18).

Isolated from soil at Caruaru (Pernambuco), by Epaminondas BARROS.

This fungus also grows fairly on P.D.A., carrot-agar, Sabouraud-agar, but on Czapek's-agar growth is none or very thin. Our isolates were mated in various combination with the type strain of *G. lacrispora* HESSELTINE and ELLIS but no zygosporés are seen.

Cultural and morphological characters of sporangiophores, sprangia, apophysis, columellae, sporangiospores and chlamydospores and their measurements of present fungus are similar to *Gongronella lacrispora*, to which its identity is referred. For this fungus I had been confused with *Circinella* species because of circinate sporangiophores at the top in two cultures from soil. Indeed these both cultures were also *G. lacrispora*. So far, this species gets reported from United States of America, therefore this report is of special interest to add its geographical distribution here.

The following key distinguishes two species:

1. Sporangia borne erect and not circinately on sporangiophores; stolons and rhizoids present; sporangiophores septate; sporangiospores oval to almost reniform *G. butleri*
2. Sporangia borne circinately on brittle sporangiophores; stolons and rhizoids absent; sporangiophores generally septate near apophysis; sporangiospores lacrimoid to narrowly napiform *G. lacrispora*

SUMMARY

A taxonomic study of the genus *Gongronella* has been made and it is distinguished from *Mortierella*. It is suggested to retain this genus in the family Mucoraceae because of the formation of short columellae and completely *Mucor* like zygospores. *G. butleri* and *G. lacrispora* are described and illustrated. Abundant zygospores formation in *G. butleri* is also described and illustrated. A key is presented for the identification of the two known species.

SUMÁRIO

O presente trabalho compreende um estudo taxonômico do gênero *Gongronella* cujas semelhanças e diferenças com *Mortierella* são pormenorizadamente analisadas. O autor sugere que este gênero seja mantido na família Mucoraceae em vista da formação de columelas curtas e da presença de zigósporos inteiramente idênticos aos do gênero *Mucor*. As espécies *G. butleri* and *G. lacrispora* se encontram descritas e ilustradas. A formação dos zigósporos de *G. butleri* está também abundantemente descrita e documentada. Contém finalmente uma chave analítica para a separação das duas espécies de *Gongronella*.

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EXPLANATION OF PLATES 7 (1) - 9 (3)

PLATE 7 (1)

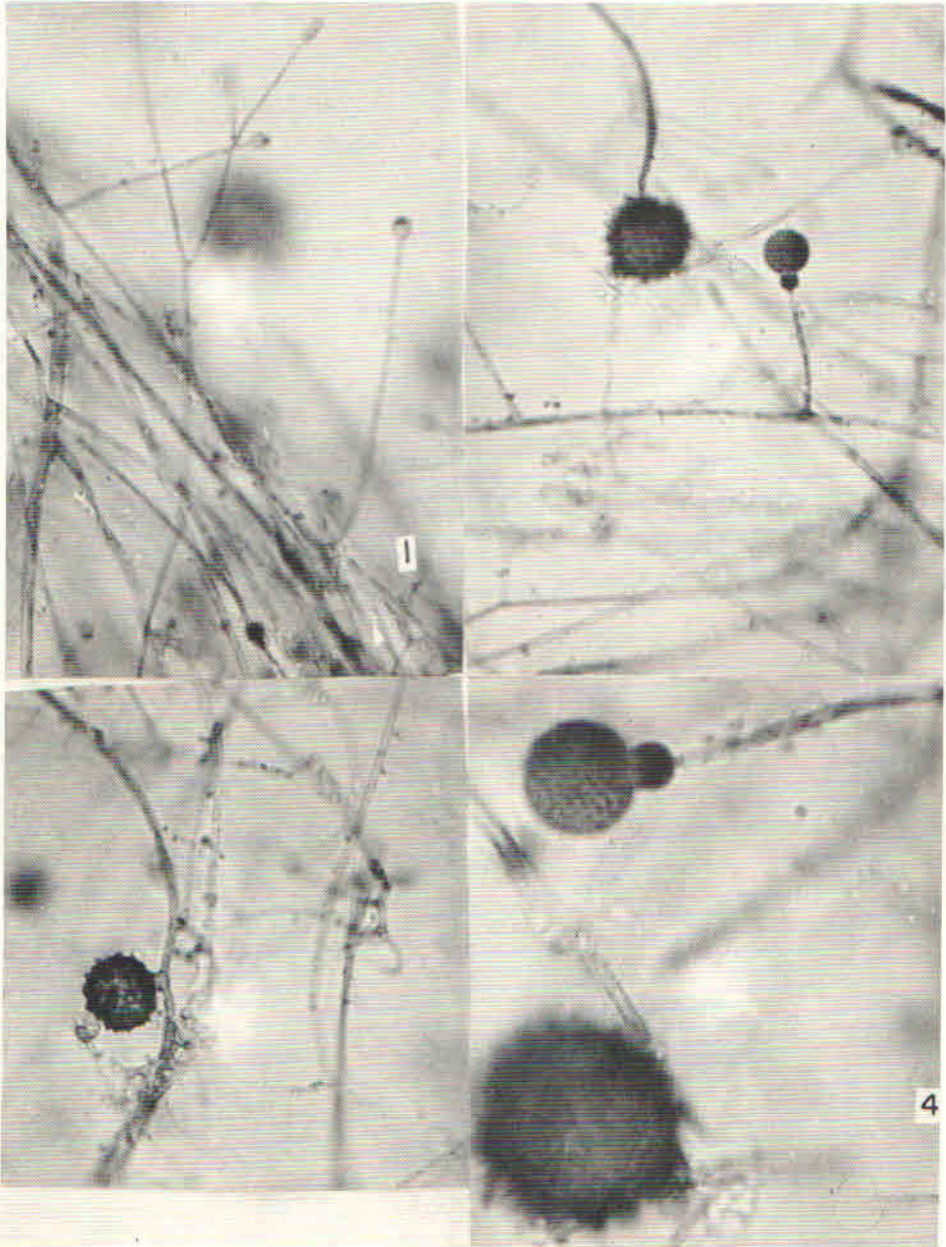
Figs. 1-4. *Gongronella butleri*:— 1. Showing sporangiophores development from mycelium and stolon (10×); 2. zygospore and sporangium with well developed apophysis (25×); 3. zygospore; 4. zygospore and sporangium with reduced columella shielded with sporangiospore (45×).

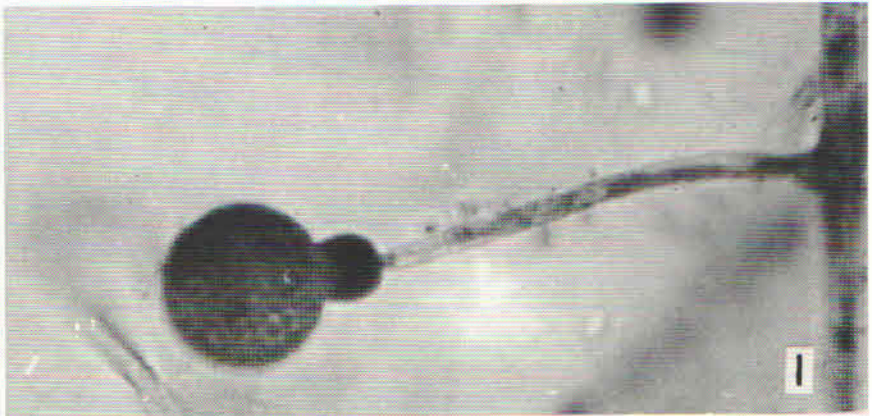
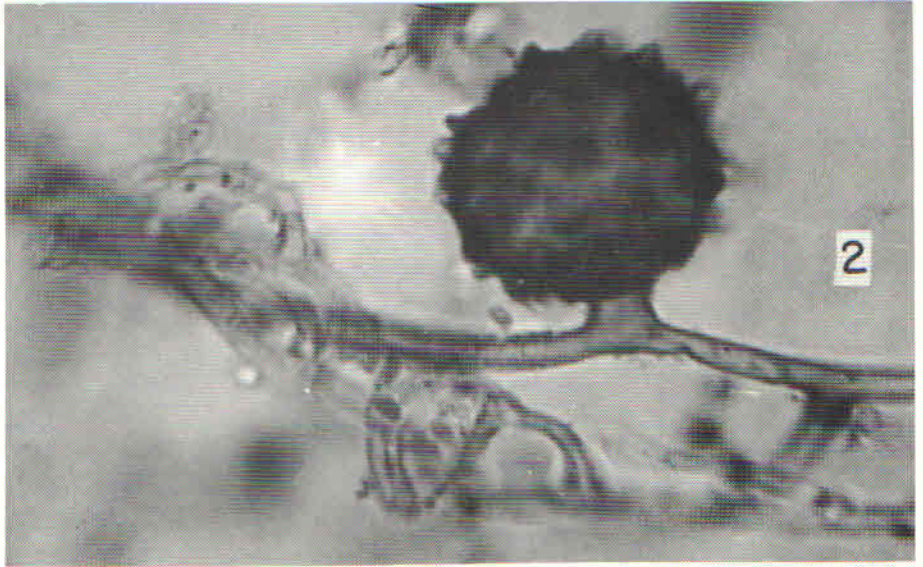
PLATE 8 (2)

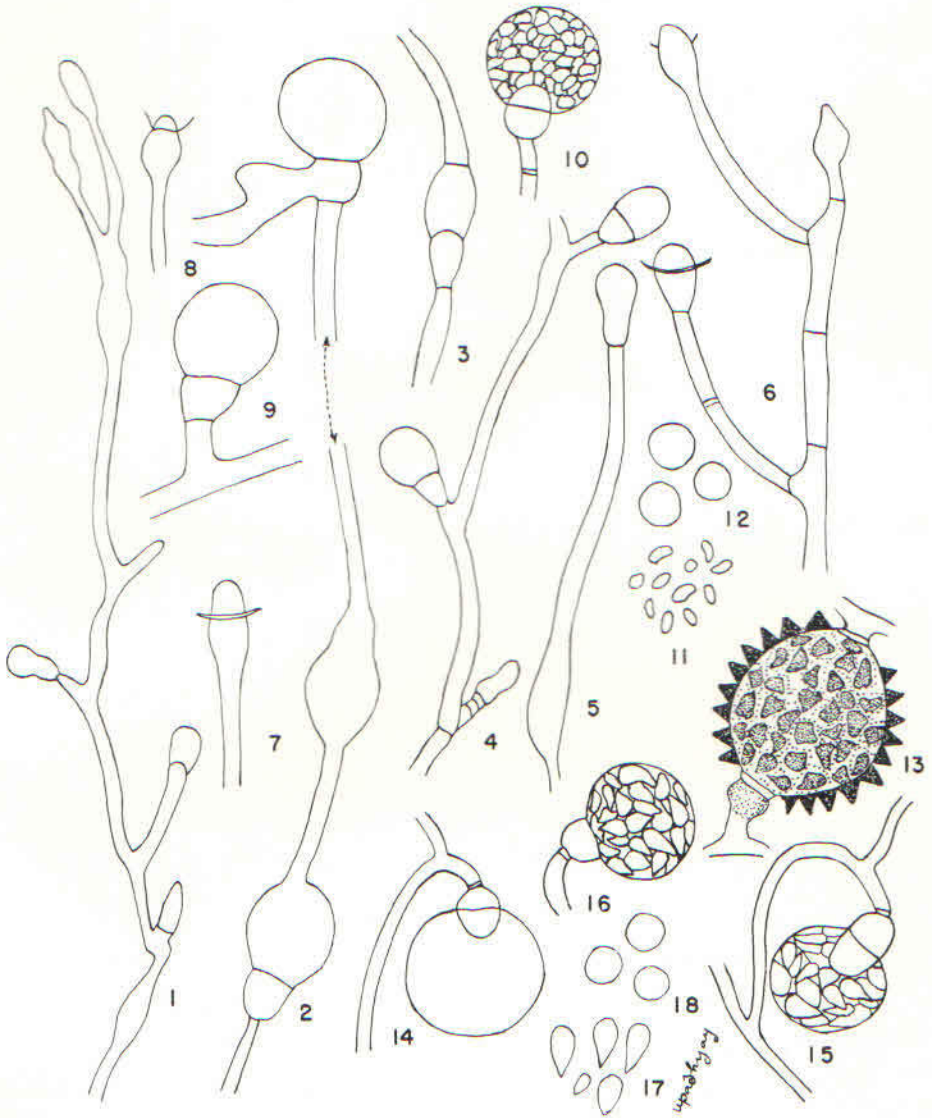
Figs. 1-2. *Gongronella butleri*:— 1. Sporangium and sporangiospores on carrot-agar (45×); 2. zygospore on carrot-agar (45×).

PLATE 9 (3)

Figs. 1-13. *Gongronella butleri*. - Figs. 14-18. *Gongronella lacrispora*.







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