Gasterospores (Chlamydospores) in Tropical Ganoderma.

By S. R. Bose (Botanical Laboratory, Carmichael Medical College, Calcutta, India).

(With Plate VI.)

In 1936 Pilát (7) stated that especially in some specimens of tropical species of *Ganoderma* there are small cavities in the trama, filled with a dense tissue of hyphae, some of which bear terminally round spores known as chlamydospores (gasteroconidia). These terminal chlamydospores get detached and become free; some of them develop intercalarily, and later on, get detached with the adhering fragments of parent hyphae. These chlamydospores differ little from normal basidiospores, each like basidiospore has two walls — one endospore, brown and ornamented, and the other hyaline epispore. The white hyaline hyphae filling up the cavities stand in contrast with the brown hyphae of the trama.'

In Mycologia, 1933 and 1935 (1 and 2) I published an account of such gasterospores in some of our local *Ganoderma* and attempted to ascertain the probable cause of their formation in nature by water experiment in the laboratory. Since then, I have noted in my rich collection (about 1,000) of tropical *G. lucidum* (Leys.) Fr. and *G. applanatum* (Pers.) Wallr. only sixteen specimens the hymenial surfaces of which show a number of scratches, both deep and shallow with channels of varying lengths (Fig. 1). In most of these besides the basidiospores in the hymenium, abundant gasterospores (chlamydospores) are found in the context and the trama; their measurements almost agree with those of normal basidiospores. Usually in normal specimens of Ganoderma not a single gasterospore (chlamydospore) is found in the tissue of the context. I have further noticed that in some cases a few mature spores which at first sight look round under the microscope, become oval when the coverslip is pressed.

Experimental Results.

1. I repeated twice the water-experiment of 1934 (2), on the 14th. September and on the 40th. November, 1955; each time a specimen of *G. lucidum* attached to the substratum (viz. the buried root of a *Ficus bengalensis* tree in our College compound) was removed with a portion of the buried root and exposed to showers of tap water in the laboratory continuously for nine days (day and night) from 14th. September to 23rd. September, 1955 and from 30th. November

to 9th. December, 1955. When subsequently examined in the moist condition the context of the specimen showed a number of round typical gasterospores (chlamydospores) directly attached to hyphae, of varying sizes, 13 to 16.9 μ in diameter; dried for another 13 days (i. e. upto 6th. October, 1955) at room temperature under cover of a blotting paper their diameters shrank to 9.1—5.2 μ. These gasterospores particularly abounded in the region of the context where there was plenty of hyaline hyphae and they remained perfectly round even when pressed under the cover-slip. My experiment imitates what actually happens to *G. lucidum* when they are exposed to continuous showers for days together in tropical forests.

II. On 27th. September 1955, three specimens of *G. lucidum* growing in the Indian Botanical Garden, Calcutta (Sibpur), on the main trunk of a living tree of *Casuarina equisetifolia* at about six inches from the ground level, were cut on the hymenial surface by several deep and shallow longitudinal scratches (Fig. 2). They were watched growing normally for one month (27th. September to 27th. October, 1955). During this period there were frequent showers of late rains and continuous showers of rain for 2—3 days during the fourth week of October, 1955. The specimens were ultimately lifted on 27th. October, 1955, and brought to the laboratory. The scratched areas on the lower surface showed signs of partial healing with thin crusts at places.

These partially healed areas were sectioned as well as scraped with needles and were examined microscopically when they revealed a large number of round, hyaline and slightly oval brown gasterospores directly attached to hyaline hyphae in the thin context and the trama besides basidiospores in the hymenium. The measurements of these round gasterospores (chlamydospores) were from 6.5 to 16.9 μ in diameter. These gasterospores were found in all stages of transition from hyaline to brown form with endospore gradually differentiating out as a series of granules on the inner side of the epispore, which later fused to form a membrane. These observations agreed precisely with those recorded and illustrated with figures by Coleman (6) about the development of wall of the basidiospores of *Ganoderma*. This scratching experiment was repeated on another set of specimens of *G. lucidum* on the main trunk of a different tree of *Casuarina equisetifolia* growing in the same garden on perfectly rainless days from November, 1955 to January, 1956 (2 months). During this period a specimen was lifted every fortnight, and examined microscopically when exactly similar results were obtained; a partial healing of scratches on the lower surface with a thin crust on the whitish mycelial pad was observed; sectioned, they showed a number of gasterospores directly attached to living hyaline hyphae in all stages of development as described above.

Normal specimens of *G. lucidum* and *G. applanatum* usually at the end of the rainy season, show, within their pore-tubes besides basidia, a large number of hyphal projections bearing at their summit asymmetrically secondary spores that are indistinguishable from ordinary basidiospores in shape, size and ornamentation of the spore- wall. These were rightly called by Buller (5) 'secondary basidiospores'. Bose (3 and 4) has already dealt with these points elsewhere.

Conclusion.

From these results it is concluded that gasterospores (chlamydospores) are formed in tropical *Ganoderma* under one of the following conditions viz., (1) coninuous rain for days together during the season or (2) scratches on the hymenial surface caused by insects, borers or accidental abrasions by leaves, roots, stems etc., as these become embedded in the course of growth. Evidently, gasterospores are formed in nature, to tide over adverse living coditions; they are entirely different from the basidiospores and secondary spores as regards their origin though they may agree in the mode of development.

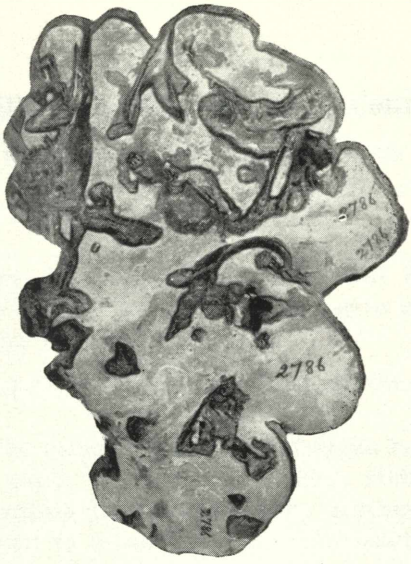
I wish here to express my gratitude to Mr. P. P. Sen, Lecturer of our Botany Department for technical assistance during this investigation.

Literature.

1. Bose, S. R. Abnormal spores of some Ganoderma. Mycologia **25**: 431—434, 1933.
2. — Further notes on „Gasterospores" in *Ganoderma lucidum*. Mycologia **27**: 88. 1935.
3. — Cytology of secondary spore formation in *Ganoderma*. Phytopathology **25**: 426—429. 1935.
4. — Moisture-relation as determinant factor in the transformation of the basidia of certain *Polyporaceae*. Mycologia **35**: 33—46. 1944.
5. Buller, A. H. R. Researches on Fungi. Longmans Green & Co., London. Vol. V. p. 22. 1933.
6. Coleman, L. C. Spore-wall in *Ganoderma*. Bot. Gazette **83**: 48—60. 1927.
7. Pilát, A. *Polyporaceae* I. Atlas des Champignons de l'Europe. Praha, 1936.

Explanation of Plate VI.

Fig. 1. *Ganoderma lucidum*. Hymenial surface showing natural cavities.
Fig. 2. *Ganoderma lucidum*. Hymenial surface, artificially scratched.



1

2