A NOTE ON THE LIFE-HISTORY AND THE SYSTEMATIC POSITION OF *RHINOSPORIDIUM SEEBERI* (WERNICKE)

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Various cases of rhinosporidiosis on man, horse and cow have been reported from all over the world. In India it has been observed in Bengal, Madras, Poona and other parts (Allen, 1935; Allen and Dave, 1936; Anantnarayan Rao, 1938; Beattie, 1906; Cherian and Vasu Devan, 1929; Karunaratne, 1936; Krishna Murti, 1931; Kurup, 1931; Mandlik, 1937; Noronha, 1933; Norrie, 1929; Sahai, 1938).

In the present case the rhinosporidiosis has been studied on cow, bullock and pony. The material was obtained by one of the authors (Balbir Singh) from various places in C.P. The nasal polypi of these animals along with their fæces and nasal excretions were fully studied. The microtomic sections of the polypi were also prepared.

The systematic position of the causal organism, *Rhinosporidium seeberi* has been so far a disputed question. An attempt has been made in the present publication to throw some light on this.

Young Stage

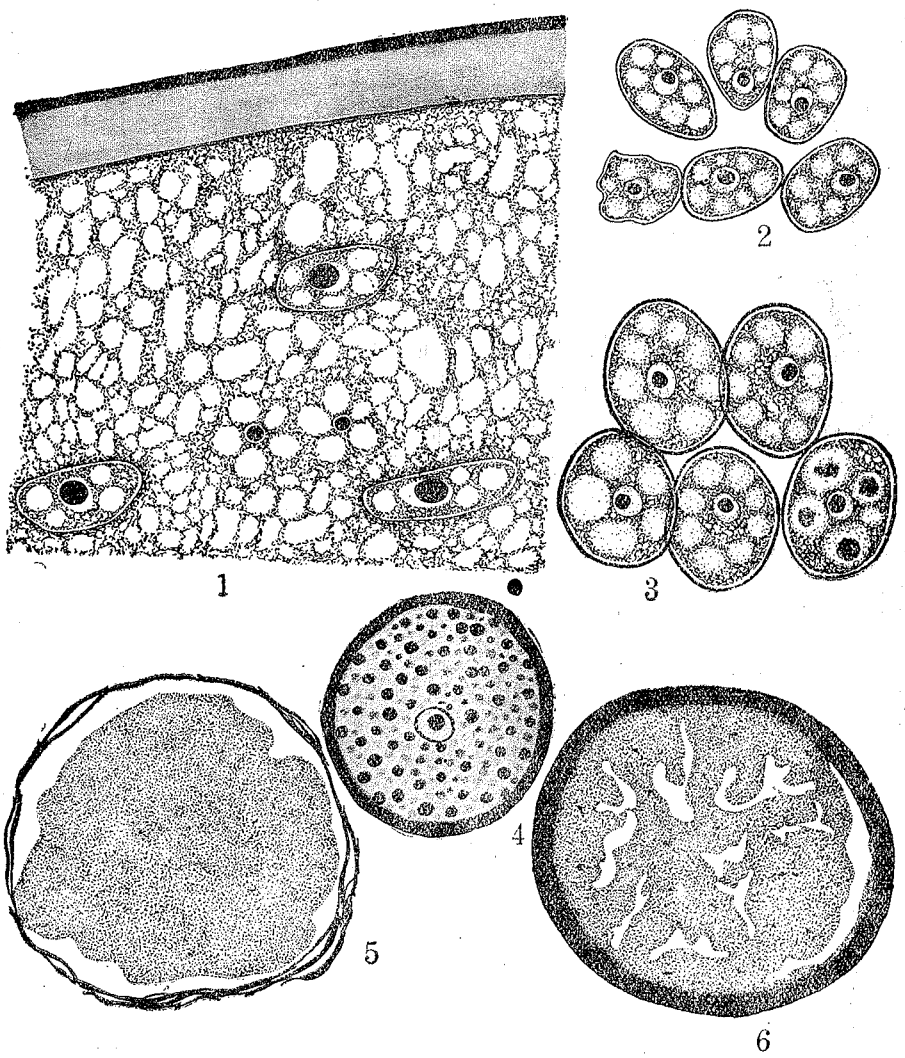
The parasite, as far as observed, starts its life-history with a small, spherical, oval or oblong body, sometimes with irregular boundary, inside the connective tissue cells of the polypus (Fig. 1). It measures 5–9 μ, the average being 6–8 μ in diameter. There is a nucleus with a distinct karyosome. The cytoplasm is granular and contains a few spherules (Figs. 2 and 3).

Trophic Stage

The parasite then enters a period of very active growth and considerably enlarges in size with corresponding accumulation of nutritive material in the form of spherical globules and increase in the size of the nucleus and the thickness of the wall (Figs. 4 and 12).

During the earlier part of the trophic stage the parasite remains more or less roundish and measures 13 μ to 65 μ in diameter. The wall is 1·3 μ to 5 μ in thickness and the size of the nucleus is 4 μ in a parasite which is 38 μ in diameter while it increases to 7 μ where the parasite attains the size of 60 μ in diameter. Later on the parasite becomes perfectly oval (Fig. 13) and measures from 91 μ to 130 $\mu \times 74 \mu$ to 78 μ. The thickness of the wall increases upto 9 μ as observed in a parasite

80 μ in diameter. In larger parasites the wall is comparatively thinner, being 7–8 μ thick.

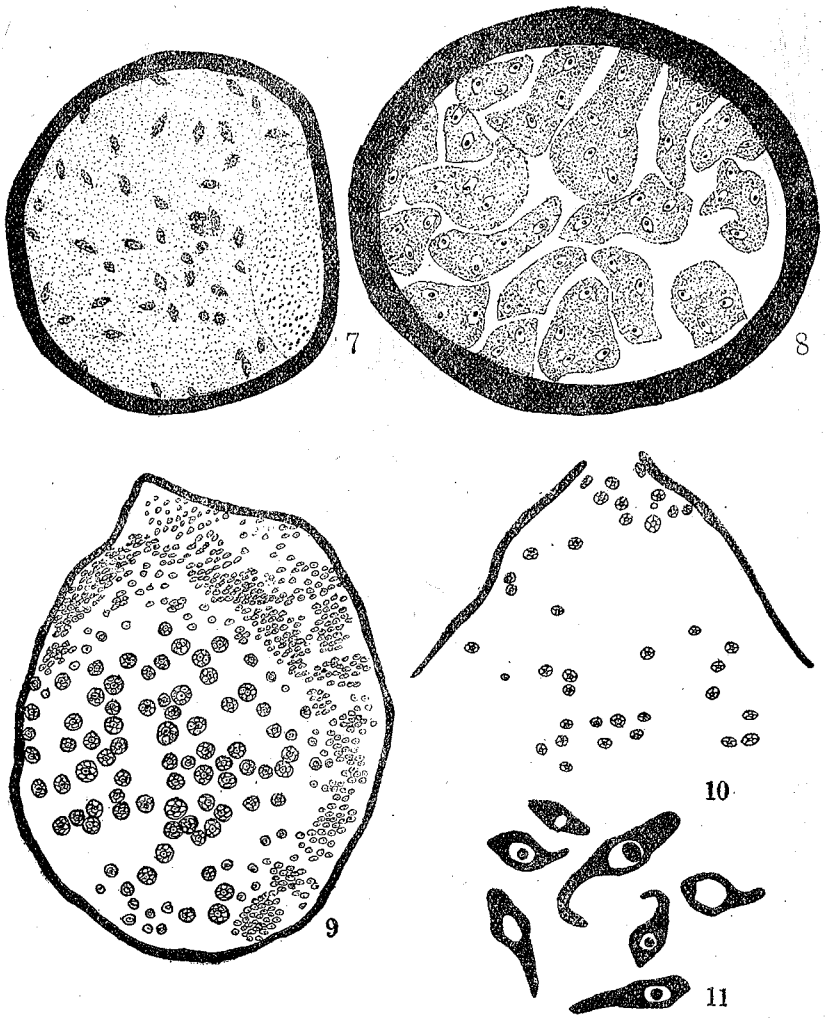


Figs. 1-6.—Fig. 1. Section of the polypus with spores in the connective tissue cells. Fig. 2. Young spores showing envelope, the nucleus with karyosome, the cytoplasm and the vacuoles. Fig. 3. Spores at a later stage of development than in Fig. 2. Fig. 4. Trophic stage. Fig. 5. Showing reduction in the size of the spherules and globules. Fig. 6. The nuclei formed after mitotic division. Figs. 1–3, × 2700 ; Fig. 4, × 1500 ; Figs. 5 and 6, × 510.

An important change now takes place in the size of granules and spherules, which were much larger in the beginning but become reduced in size later on, just prior to the nuclear division (Fig. 5).

Nuclear division

After the maximum growth period the nucleus of the parasite shows very active mitotic division. Several thousand nuclei are thus formed before the commencement of the cytoplasmic division (Figs. 6–7). The size of the parasite goes on enlarging and during the period of cytoplasmic division it varies from 144 μ to 109 μ × 130 μ to 90 μ. The thickness of the wall is from 4–9 μ.



Figs. 7–11.—Fig. 7. More nuclei formed after mitotic division. Fig. 8. Cytoplasmic division in progress. Fig. 9. Mature sporangium with beak at the top. Fig. 10. Pore differentiated at the top of the sporangium. Fig. 11. Germination of spores giving rise to amœboid structures. Figs. 7 and 8, × 510; Figs. 9 and 10, × 700; Fig. 11, × 1620.

Formation of Spores

Cytoplasmic division now sets in which is fully illustrated in Fig. 8. It goes on till there are formed uninucleate protoplasmic masses (Fig. 9). These round off and a wall is laid down around each. The parasite now represents a young sporangium with numerous uninucleate spores (Fig. 9). These young sporangia vary in size from 187 μ to 110 μ × 156 μ to 110 μ while the spores measure from 3–4 μ in diameter. It is interesting to note that the central spores are differentiated earlier than the peripheral ones (Fig. 9).

The sporangia and the spores further increase in size. The fully ripe sporangia measure from 500 μ to 400 μ × 400 μ, while the spores reach 6–9 μ in diameter. These measurements are much higher than those given by Ashworth (1924).

Dispersal of Spores

At any point the wall of the sporangium may protrude out into a beak (Fig. 9). The beak later on breaks and a pore is formed through which the spores are discharged (Fig. 10).

Germination of Spores

Numerous spores from which blunt processes were seen in all stages of development were observed by the authors (Fig. 11). The amœboid structures thus formed seem to be the germinating spores of *Rhinosporidium seeberi* and were found in the nasal excretions. These no doubt bring about new infection.

It has, however, not been possible to carry out the artificial germination of these spores.

Systematic Position of Rhinosporidium seeberi

This organism was first seen by Seeber in 1896 in nasal polypi of man in Buenos Aires, which he described as a sporozoal parasite (Seeber, 1900) and Wernicke named this parasite as *Coccidium seeberi* in 1900. Belou (1903) in his treatise on animal parasitology described it as *Coccidium seeberi* Wernicke, 1900. Minchin and Fantham described *Rhinosporidium kinealyi* as a new genus and a new species from nasal polypi in man from India. Beattie (1906) also described *Rhinosporidium kinealyi* from Cochin material, obtained by Dr. Nair of Madras. Seeber's parasite is a *Rhinosporidium* and is the same as *R. kinealyi.* Fantham, Stephens and Theobold (1916) call it *R. kinealyi* (or *seeberi*). The question of priority of name has been discussed by Seeber (1912) and as pointed out by Hartmann (1921) the *Rhinosporidium seeberi* Wernicke has priority over *R. kinealyi.* From the nasal septum of a horse in South Africa, Zschokke (1913) described *R. equi,* a new species. That there is any specific difference between the human and equine form seems doubtful (Wenyon, 1926). All these authors regarded *Rhinosporidium* as a protozoa. Ridewood and Fantham (Fantham, 1907) in their classification put *Rhinosporidium* in subsection Polysporulea under Haplosporidia. Doflein (1906) also retained it in

Polysporulea but stated that it had many resemblances with *Chytridineæ*. Ashworth (1923) conclusively demonstrated that these were vegetable parasites. He gave a detailed account, calling it *Rhinosporidium seeberi* and related it with lower fungi for the following reasons :

(1) Presence of fatty reserves, (2) repeated nuclear division preparatory to spore formation, (3) division of cytoplasm at a later stage, (4) absence of residual cytoplasm, (5) presence of a mucoid substance between the spores, (6) wall being made up of cellulose and (7) formation of a definite pore in the sporangium.

As the thallus in *Rhinosporidium* is formed of a single cell and the mycelium is wholly lacking, Ashworth put the organism under Chytridineæ. The thallus of *Rhinosporidium seeberi* is holocarpic, *i.e.*, later on gives as a whole to the sporongium. So he put it in the family *Olpidiaceæ* of Chytridineæ.

The occurrence of germinating spores giving rise to amœboid structures as observed by the authors, indicates the affinity of *Rhinosporidium seeberi* to Chytridiales. The formation of zoospores has been suppressed here probably due to its peculiar mode of existence on man and other animals (Negroni, 1931).

Ainsworth and Bisby (1943) wonder if *Rhinosporidium* be put under *Endomycetales*. But from the evidence put forward it appears that it should be placed under *Chytridiales*.

It may be mentioned here that Anantnarayan Rao (1938), in his paper while giving a brief account of the organism, refers to both sporangia and asci. It seems that he has confused the two terms.

SUMMARY

Rhinosporidiosis occurring on cow, bullock and pony has been studied. The fæces and the nasal excretions were also examined. The amœboid structures formed from the germination of spores of *Rhinosporidium seeberi* were found in the nasal excretions. These structures further strengthen the affinity of *R. seeberi* with *Chytridiales*.

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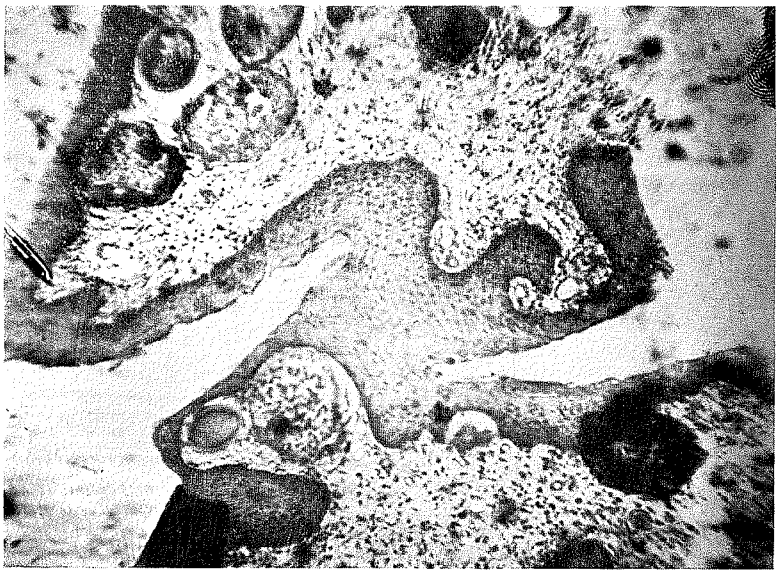

Fig. 12. Section of Polypus (trophic stage). ×95

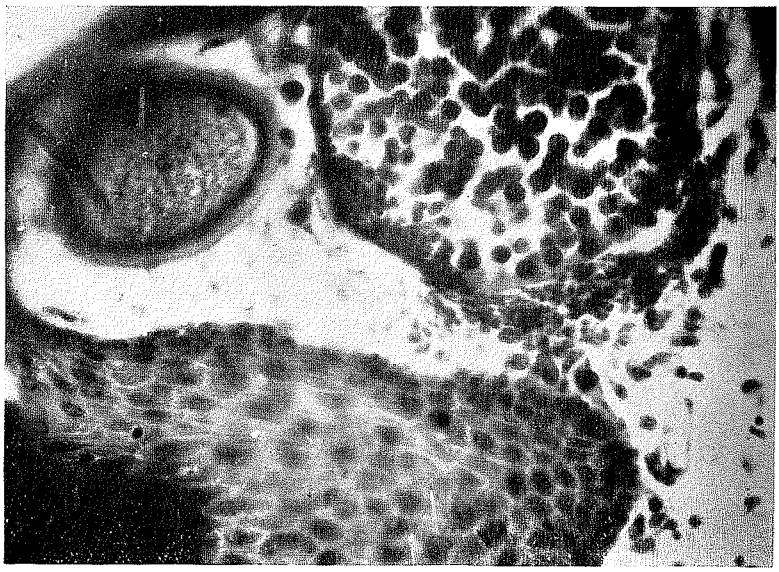

Fig. 13. Section of Polypus with mature sporangium. ×720

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