IX. SUMMARY

1. The present investigation has been undertaken to obtain information on some aspects of the biology of *Hexagonia* species causing the decay of the fruit-tree *Diospyros embryopteris* Pers. This is a new report with regard to the relationship between the host and the casual organism. It has also been studied in order to evaluate the amount of loss to the host caused by the pathogen with a view to suggest suitable control measures for the same.

2. *Diospyros embryopteris* Pers. is a fruit-tree of tropical countries. It is often cultivated for its fruit and gums the latter being often used by fishermen for their boats and fishing nets for its anti-corroding effect. The timber, commonly known as 'ebony' is also used for different purposes. Its economic importance and internal structure have also been incidentally discussed.

3. The basidiocarps of *Hexagonia* species have been found to grow on dying branches of the host-trees. In the laboratory, poly porous, monosporous and tissue-cultures have been made from freshly collected basidiocarps on 2.5 per cent *malt agar* medium. The primary mycelia derived from single spores have been allowed to pair at random for the production of typical secondary mycelia with clamp-connexions and they agreed in all respects with the isolates of the fungus obtained from infected woody tissues on
The history, synonymy, distribution, and host range of the pathogen have been discussed, together with its present correct nomenclature.

The morphological characters, anatomical characters including tissue differentiation, and hyphal system of the basidiocarps of the fungus have been described in detail. It has been found that the construction is of the 'trimitic' type consisting of generative, skeletal and binding hyphae.

The external symptoms of infected trees and the extent of decay in nature have been fully described. These trees can be easily identified due to their projecting dried up branches through lustrous green foliages. These branches have been found to be covered with the basidiocarps of Hexagonia species and with cankers of various sizes. The texture of the wood below the bark has been found to be considerable light, soft and spongy. The fibres have lost their toughness and have become 'brash'. The bark when removed shows the presence of patchy whitish mycelium here and there. The bark has been heavily cracked both transversely and longitudinally through which basidiocarps of the fungus have developed. The rotted areas at first appear as isolated patches which eventually coalesce to form wider areas. The cross-section-ends of the branches have shown rot pockets of various sizes and filled up with mycelia and dusty fibres. Considerable
discolouration of the rotted wood has also been noticed.

The microscopic details of the rot caused by the pathogen have been studied in the laboratory. The fungal hyphae have been found to be confined to the vessels and wood parenchyma. The hyphae are more conspicuous within the vessels, the paths of minimum resistance, have served as the main channels for the development of the mycelium. The hyphae run more or less longitudinally, but their branches pass in transverse directions through simple pits and directly through the cell-walls forming bore-holes. The dissolution of vessel walls has taken place partially and irregular gaps have appeared here and there due to breaking down of wood parenchyma. The fibres and all other wood elements have been severely attacked. The walls of wood elements have become thinner and in certain cases have been completely broken down along with the removal of gummy materials.

The pathogen has gained entrance through short branch stubs which usually act as portals of entry in the field condition. After killing the cambium it has entered the sapwood. The rot have progressed from the periphery towards the centre of the wood. The much branched finer hyphae in passing through the cell-walls have shown little or no diminution in diameter but the larger ones become somewhat attenuated or constricted at the spicis. The hyphae which pass through the pits have enlarged in diameter after emergence.
7. Microchemical tests have been performed in order to find out the effects of decay on the principal chemical components of the wood elements. The standard reagents have been used for these purposes in order to evaluate quantitatively the amount of depletion of both lignin and cellulosic materials caused during the process of decay especially under controlled condition of the laboratory.

8. Chemical analyses of various wood samples (sound, experimentally decayed and naturally decayed wood) have been done in order to determine quantitatively the extent of loss of different components of the wood-elements during decay. The moisture-content of the woods has been determined. Cold and hot solubility tests, presence of alkali soluble matters, total extractives, alcohol-benzene extractives, and methyl cellosolve soluble matters in sound, experimentally and naturally decayed wood have been determined. The lignin content has been found to be degraded in little quantity by both the primary and the secondary mycelia in early stage of decay, where as, the cellulosic components, including alpha-cellulose, beta-cellulose and gamma-cellulose have undergone considerable loss. The total reducing and non-reducing sugar contents as well as soluble and non-soluble nitrogenous components of naturally decayed and partially decayed wood under controlled condition have been found to be reduced remarkably in comparison to those in the sound wood.
9. Small sterilized test blocks, (5 x 2.5 x 1 cm.) from sapwood of the host, have been subjected to decay by both the primary and the secondary mycelium of the pathogen under controlled laboratory conditions for a period of four months in order to test their natural resistance to fungal decay. The magnitude of loss due to fungal attack has been calculated in every case by estimating the loss in dry weight of the test wood-blocks. It has been observed that the sapwood sustains an average loss in dry weight of 15.2 per cent due to the secondary and 10 per cent by the primary mycelia. According to Findlay's classification (1954), this wood has, therefore, been found to be 'non-resistant' to attack by the pathogen in question.

10. Toxicity tests have been carried out by following both agar plate and wood-block methods with five chemical compounds, viz., Zinc chloride, Nickel chromate, Lead nitrate, Ascu 'A' and Creosote. Creosote and Ascu 'A' have been found to be very satisfactory for controlling growth of both the primary and the secondary mycelia. The wood-blocks, impregnated separately with each of the chemical compounds, have been subjected to decay for a maximum period of four months by both the types of mycelia. It has been revealed that, irrespective of nature of the mycelium, uniformly higher concentrations of the chemicals are necessary to check the fungal growth completely.
11. *Hexagonia* species being a 'white spongy' rot producing fungus, gives strongly positive oxidase reaction in standard tests both with the primary and the secondary mycelia. These tests also indicate that the secondary mycelium is more vigorous in producing extracellular oxidases than the primary one.

12. The study on sexuality has revealed that *Hexagonia* species is a 'heterothallic' species with 'tetrapolar' sex factor. The different types of reaction exhibited during mating-experiments has also been described.

13. Physiological studies with the pathogen have been done in detail with regard to both the effects of physical and chemical environments on growth.

14. The different temperature used in the experiment are 15°, 20°, 25°, 30°, 35°, and 40°C. to find out its role on the vegetative growth of the test-fungus. It has been found that 35°C. is the optimum one.

15. To determine the role of different light sources on the vegetative growth of the test-fungus, continuous light, different spectral ranges of continuous light, complete darkness and alternate light and complete darkness, have been chosen. Alternate light and darkness have been found to be the most suitable for growth purposes. Blue, green, yellow and red lights comes next in successively of all the sources, red light has the maximum
inhibitory effect on growth. The various reactions on growth have been explained on the basis of established ideas.

6. The effects of different range of hydrogen-ion-concentration on growth have been noted. It has been observed that *Hexagonia* species is acid loving one, the optimum pH for the growth being 5.5.

7. Various types of liquid medium have been tried to note the effect produced by them on vegetative growth of both the types of mycelia of the test-fungus. It has been observed that *potato-dextrose* is the best medium for this purpose.

8. In order to find out the role of carbon on growth of the test-fungus different sources of carbon including sugars and organic acids have been used in this experiment. The experiments with organic acids have been abandoned due to poor responses by both the types of mycelia of the test fungus having low growth characteristic due to pH of the medium. Of the sugars, Glucose is the best chemical and is followed by maltose, starch, sucrose and laevulose in succession. The mechanism of carbon reactions on growth of both the types of mycelium of *Hexagonia* species has been discussed on the basis of the present day concept.

9. The role of nitrogen on vegetative growth of the test-fungus has, also, been evaluated. Of the different sources of organic and inorganic nitrogen tested, 0.2 per cent Glycine and Ammonium
• nitrate undoubtedly appear to be the best sources respectively.

20. Inoculation experiments have been done on healthy young saplings of *D. embryopteris* in the experimental garden of the University College of Science, Calcutta University. It has been observed that in all cases the plants have been found to take up the infection within one month and show more or less similar symptoms, which have been recorded from the disease plants in the field. This clearly indicates that the fungus in question can infect healthy plants in the field through wound and is, therefore, regarded as a wound-parasite.

21. Probable measures for controlling the disease have been tentatively suggested and these are of a protective rather than of therapeutic nature.