Merulius lacrymans (Wulf.) Fr. in India.

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With plate I—III.

The true „dry rot" fungus, *Merulius lacrymans* (Wulf.) Fr. (Hausschwamm) of temperate, Central and Northern Europe has been recorded in building timber in the hill stations of North India at an altitude of about 7,000—8,000 ft. and in the temperate regions of the inner Himalayas in the open forest, at an altitude of about 8,000—10,500 ft. The fungus was first noticed in October 1929 in Pulga, Kulu, Punjab (I). Kulu is a Himalayan district, about sixty miles north of Simla, as the crow flies, an area of some two thousand miles composed of rugged, forest-clad mountains.

The radiating fan-shaped mycelium occurred on the ceiling made of spruce (*Picea morinda*) boards, in the Forest Rest House at Pulga. Mature sporophores were collected in the felling coupes on grounded logs of spruce and fir (*Abies pindrow*) in the vicinity of the rest house (Pl. I, fig. 3). In October, 1941, the fungus was noticed in Taranda 50 miles north of Simla in upper Bashahr, in the Himalayas, at an altitude of 8,000 ft. under the spruce floor boards of an unused lumber room (Pl. V, fig. 1). In June, 1946, the fungus was again recorded under the floor boards of the recreation hall of the United Services Club, Simla, a building partly destroyed by fire. In all the three cases the origin of infection was traceable from the felling coupes at Narkanda, 9,200 ft., thirty nine miles north west of Simla from where the spruce planks for the construction of the buildings were obtained. It was in August, 1946 that after an extensive search in the spruce and fir forests, mature sporophores were located in the coupes at Narkanda (Pl. V, fig. 2). In Simla the club building was constructed of deodar planks; even then the initial attack had started in the spruce beams in contact with the ground, the abutments of which were fixed against the sloping embankments of the hillside. This ensured a high moisture content, from the constantly trickling water, favourable for the growth of the fungus.

The fungus was also recorder from another part of North Western Himalayas, Mundali, Chakrata division, Uttar Pardesh in 1943 in a felling coupe of spruce and fir.

Recently in October 1952, the forests of Pulga were again searched after fifteen years; the fungus was recorded on spruce and

fir in the same area. In another forest, approximately twenty miles north east of Pulga, at a higher elevation, 10,000—10,500 ft. altitude the fungus was noticed on decaying timber of fir (*Abies pindrow*) in a forest destroyed by fire, eight years back. On the burnt logs of fir however, the fungus was found growing vigorously (Pl. VI, fig. 1). along with three other brown rot fungi *Poria carbonica* (Pl. VI, fig. 2), *Fomes roseus* (Pl. VI, fig. 3) and *Lenzites subferruginea* (not shown in the photograph). In the photograph, taken in the forest, the log in the background shows the advanced stages of decay due to *M. lacrymans*.

The young sporophores under the floor boards in Simla and Taranda were made up of soft mycelial sheets, forming thick, fleshy cushions (Pl. V, fig. 1) of light yellow margin changing to reddish and purple brown and finally „russet" (Pl. VII, figs. A, and B). The hymenial surface is smooth in the beginning, but becomes uneven-nodose late in the spring (A). In August, the thick cushions spread out as thin, soft, shelving structure on which labrinthiform ridges were formed, the uneven surface becomes later on pitted (A, and B) and finally obtusely toothed (C); in September the rusty-red spores are discharged in profusion (E).

The leathery mycelial sheets of the young fruit bodies which covered extensive areas on under surface of the logs were 1—4 meters long and 10—60 cm. wide. The sheets could be easily peeled off from spruce logs in contact with the ground or embedded in the saw dust. The shelving sporophores, (Pl. V, fig. 2, Pl. VII, fig. B), one and half meter in diameter, were formed along the cut sections of the logs. The developmental morphology of the fungus is similar in both building timber and on the logs in the felling coupes in the open forest. In all the three cases the building timber attacked was spruce and in the felling coupes, spruce and fir.

In the forest *M. lacrymans* was also found attacking felled logs of spruce, in association with *Polyporus abietinus*, (Pl. V, fig. 3) a common white rot of conifers in the Himalayas. In such cases the virulence of *M. lacrymans* which is a brown rotter was observed to be much less since a white rotter was associated with it.

In the open forests, the mature sporophores on the surface of the logs developing under diffused light are effused-reflexed to reflexed, thin, leathery becoming fibrous on drying, colour varying from „orange brown", „russett" and „tobacoo brown"; dried specimens change to „fuscous black" on hymenial surface. The upper surface wrinkled to nodose when dry, giving the appearançes of scales. Context fibrous, hyphae thin-walled or slightly thick-walled, hyaline to light brown with clamp connections; basidia long, cylindrical, persistent 13—17 ⇌ 8—10 μ with 4 stout sterigimata, 4—5.5 ⇌

1.5 μ (Pl. VII, fig. 4) spores orange-yellow to rust coloured, guttulate (Pl. VII, fig. E), elliptical, thick-walled, average dimension 8.5 ⇌ 5.0 μ. The spores failed to germmate, both in the forests, in Kulu immediately after collection where the temperature in October remained 10°—15° C and in the laboratory in New Forest, in November, when temperature was 16°—20° C.

The occurrence of *M. lacrymans* in the building timber, as well as in the open forest, in different places in India, reopens the old controversy, not only regarding the diagnosis of the plant as *M. domesticus* and *M. silvester* (Falck 1912, Schulze 1936, Reichert 1938 and Findlay 1946) but also to its origin in the forests and the possibility of its invasion into the human habitations, a point recently raised by Findlay (1951). Bourdot (1927) mentions that *M. lacrymans* [*Gyrophana lacrymans* (Wulf.) Pat.] was recorded by Ludwig (according to Prillieux). He also refers to Romell who noticed that on the forest trees the fungus maintained the character of the type.

Falck (1912) distinguishes two species, *M. domesticus* Falck and *M. silvester* Falck, The latter is probably *M. himantioides* Fr. according to Findlay (1946), based on the width and height of the folds of the trama sheath, and a third species, *M. minor* Falck, also included in the *lacrymans* groups, from the delimitation of the fertile from the sterile region of the mat, also from other physical characters of the mat and fruitbodies, such as the thickness of the rim (the advancing region) diamter and thickness of the fruit giving zone height and thickness of the hymenial folds and the diameter of pores therein, character and composition of the trama, plate, smell, colour of the fruitbodies and colour of the spores. From a critical examination of the tables of comparison of the species the distinction appears more subtile than real as it is now held from the studies of the biological forms of woodrotting *Hymenomycetes* that such variations in the form the fungus do not present sufficient grounds for specific distinction. Such variations in the physical characters as those detailed in the two forms of *M. lacrymans, M. domesticus* and *M. sylvester* (*M. himantioides*) are due to „reaction physiologic" i. e., environmental and nutritional differences rather than to the inherent genetical characters.

In the microscopic diagnosis of the elements of the size of the fruiting body, of the basidia and the spores as shown by Falck's measurements, particularly in the diameter, 5—8 μ in *M. domesticus* and 8—10 μ in *M. silvestris* — and that of the spores fixed mean 5.2 ⇌ 5.5 ⇌ 9.6 μ in *M. domesticus* and 5.6 ⇌ 6.2 ⇌ 9.7 μ in *M. silvester,* representing three dimensional measurements, namely lateral, dorsiventral and length, also point to the same conclusion that they also

do not indicate critical dignostic characters for specific distinction. The characters of the hyphae which include mean diameter, thickness of walls and that of the trama sheaths also are not considered as specific characters.

In recent publications (Basham et all 1953, Davidson and Lombard 1950) have mentioned that *M. himantioides* Fr. and *M. brassicaefolius* Schw. are not specifically distinct from *M. americanus* Burt. and *M. silvester* Falck is also the same as *M. americanus*. The physiological criterion between *M. lacrymans* and *M. silvester* (= to *M. himantioides* = *M. americanus*) being the low temperature requirements (18—20° C) for optimum growth of the former and high temperature requirements (26—28° C) for optimum growth of the latter.

Lastly, data relating to the mycelia, the germination of the spores, the optimum temperature of growth, and the colour of the mycelia and the reverse of the plate (the „obstruction colours" according to Falck) point to the same conclusion that the „physiologic" variations in the characters also do not support specific distinction. In the light of the recent research on the biologic forms much importance has been given to the genetical aspect of the species and the validity of such forms which appear to overlap in their morphological characters is now tested by genetic rules, by pairing of monosporous mycelia, (as done Mounce, Nobles, Mcrae and Mckeen). This is not difficult with those forms which have clamp connections in the hyphae and also produce oidia in culture as stated by Falck.

More than 40 years have passed since the publication of Falck's diagnosis of three species of *Merulius*. The interest in the various forms of *M. lacrymans* in western countries is now centered round one form only, namely *M. domesticus,* the fungus being the most destructive building rot affecting the economics of building timber in Western and Central Europe. The other species has now been reduced to matters of academic importance. In India, however, the occurrence of *M. lacrymans* in the same locality, fructifying, annually on grounded logs for more than 12 years but occasionally attacking building timber in the neighbourhood, has created interest in the biology of the fungus as well as in its identity. The fungus has also been observed to produce normal fruitbodies on charred timber, the attack having apparently originated in the log of which the charred timber formed a part. The fruitbodies of this material (Pl. II, fig. 1) are also heavy, shelved, with colour and configuration comparable to *M. lacrymans* in all morphological details. But as the season was late autumn the development of the trama, rim, etc., and the formation of the fertile zone could not be observed as in the case of the previous material from the Simla Hills. But valid nomenclature of the

biological forms can be secured only after pairing experiments and compatibility tests. For this one has to wait for opportunity, the localities being far away from the laboratory and one's normal sphere of work.

M. lacrymans is a native of the inner Himalayan forests and its invasion of building timber has been observed. From general observation it appears that the plant is present in one form only, in all the three localities, and has been recorded in building timber as well as in felled trees; this has yet to be confirmed by critical cultural experiments.

Wooden buildings although a necessity are not yet in vogue in India. The possibility of utilising our coniferous timber for this purpose is being explored at present and the establishment of a factory in Kashmir for the large scale production of building parts planed. The grave menace of *M. lacrymans* and other potential dry rot fungi in the hills (an account of which will be shortly published in Indian Forest Records) must not be underestimated at this juncture precautionary measures to prevent their migration from forest to human habitation should receive proper consideration.

In conclusion, he writer gratefully wishes to acknowledge the help from Dr. W. P. S. Findlay, Forest Products Research Laboratory, Princes Risborough and Dr. Ross W. Davidson, Division of Forest Pathology, U.S.D.A., Beltsville, U.S.A., in confirming his identification. The writer is also greatly indebted to Dr. I. Reichert, Plant Pathologist, Agricultural and Horticultural Research Institute, Rehovot, Palestine, for sending him the extracts from Prof. Falck's paper (1912) in connection with the diagnosis of the three species of *Merulius*.

The colours described in the paper under inverted commas are based on Colour Standard and Nomenclature by Ridway (1912).

Explanation of plate I—III.

Plate I. Fig. 1. Sporophores of *M. lacrymans* on planks of *Picea morinda*. — Fig. 2. Mature sporophore from felled logs. — Fig. 3. Mature sporophore of *M. lacrymans* on a decaying log of spruce in the felling coupe. (Jointly with *Polyporus abietinus*). — Fig. 4. A basidium of *M. lacrymans* with spores. × 1000.

Plate VI. A. *M. lacrymans* on a charred log of *Abies pindrow*. — B. *Fomes roseus* on a charred log of *Abies pindrow*. — C. *Poria carbonica* on a charred log of *Abies pindrow*. Note the decaying timber in the background.

Plate VII. A. The rolling edge of the mycelium from under surface of the log spreading towards sawdust and slash on the ground in June—July. × 0,8 — B. Sporophores formed along the cut surface of the log in August—September (cf. Pl. V, figs. 2 &3). × 0.8. — C. Hymenium showing pore-tubes and septa. × 4. — D. Section of hymenium at right angles to the trama. × 4. — E. Spores in different orientation. × 1000. — F. Rot in the wood showing the type decay. × 0.8.

Fig. 1.

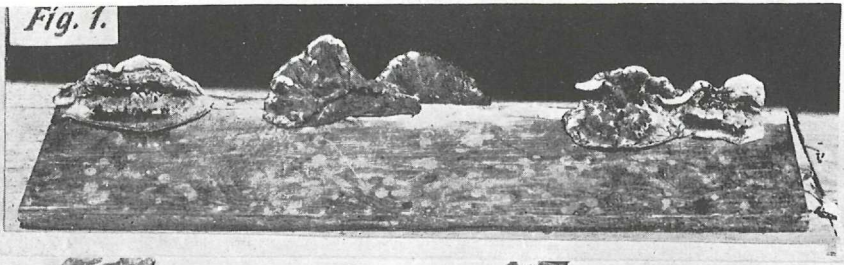


Fig. 2.

Fig. 3.

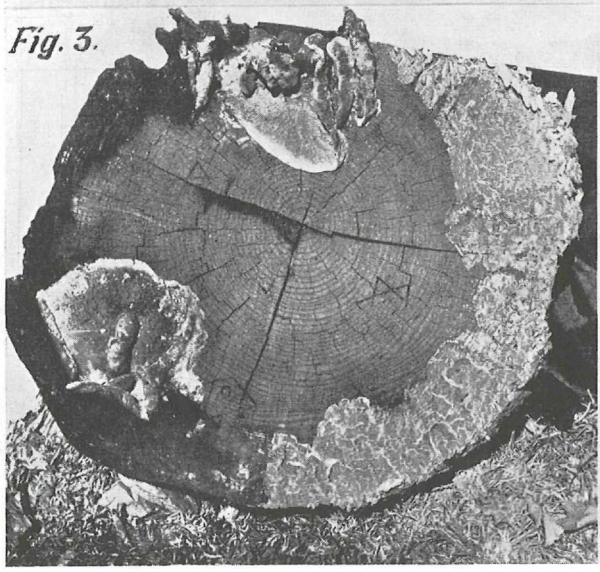
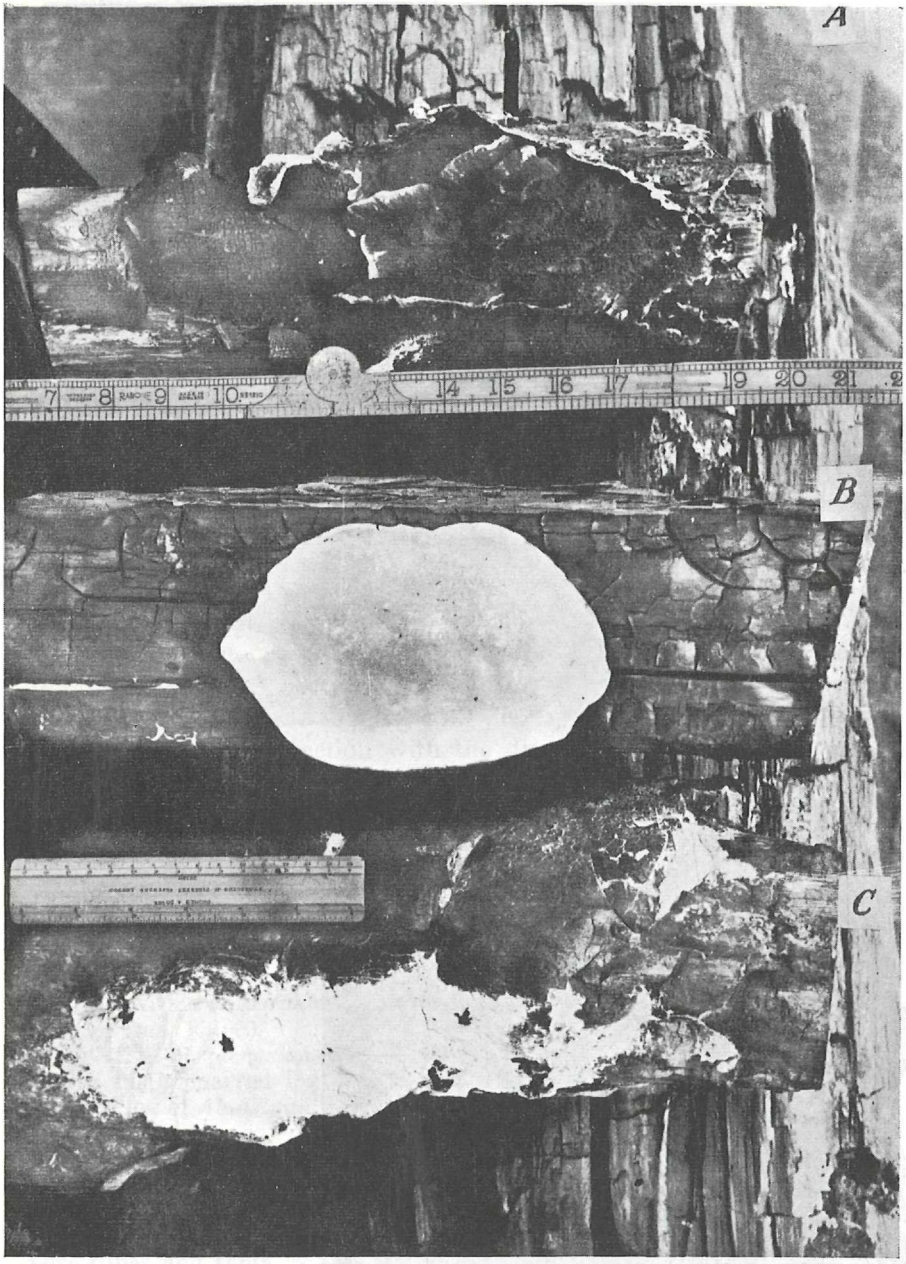
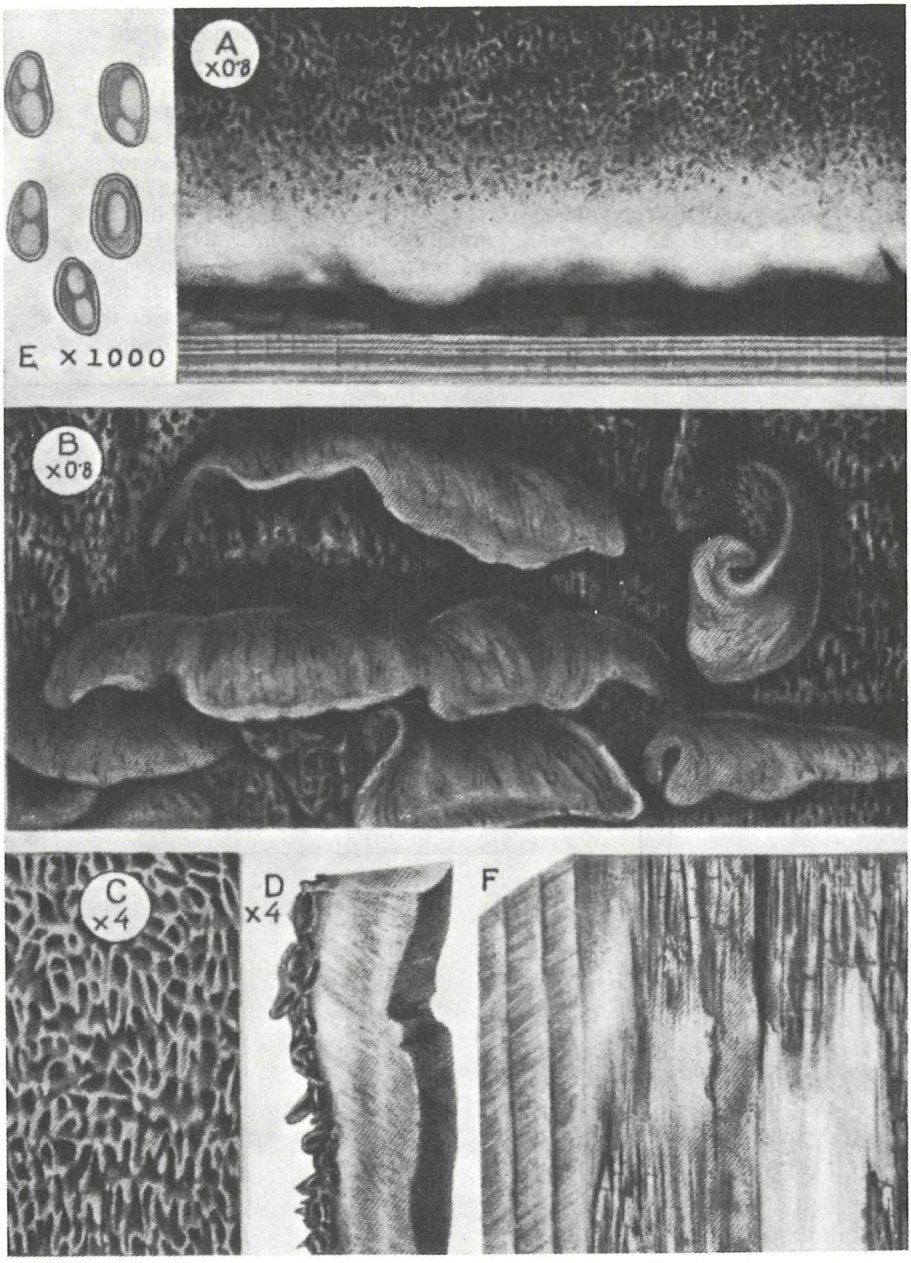


Fig. 4.

x 1000





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