

understand how relatively slight climatic changes may alter completely the character of a vegetation in a given region, and thus to comprehend more readily the changes which must have taken place in past ages. It also shows us the effect of present changes, particularly in regard to the destruction by man of the essential elements of natural plant communities, notably one of the most important of these, the forests. Its use lies in these directions and the danger of its misuse lies in the direction of drawing too positive conclusions from data which are insufficient, and of accepting the results obtained as necessarily final, a common error it is true in any line of thought, but one to which the ecologist has especial temptation.

(*To be continued.*)

## COLLECTING AND STUDYING BOLETI

BY WILLIAM A. MURRILL

The *Boleti* are fleshy, tube-bearing fungi, the tubes separating quite easily from the flesh of the pileus and from each other. They usually occur on the ground in woods, not more than five of our species being found on decaying wood, and one being parasitic on a puff-ball.

The group always attracts attention on account of the brilliant colors and ephemeral character of its species, and is of special interest because of the large number of edible fungi found in it. One section, with red tube-mouths is considered distinctly dangerous, and some species are too bitter to eat ; but with caution one might perhaps use for food over ninety per cent. of the *Boleti* he finds.

*Boleti* may be collected at any time from June to October, especially if there are frequent rains. In this latitude, July and August usually furnish the largest number of species. To make good specimens of *Boleti* for scientific purposes is probably the most difficult task that presents itself to the field mycologist, and one that he often shirks ; which accounts for the scarcity of good specimens of these plants in most herbaria. With some care

and attention to details, however, it is possible for almost any one to do creditable work in this group, and greatly to aid the cause of science in the correct description of species and their proper relations to each other.

Notes made from the fresh specimens are exceedingly important in the case of the *Boleti* because the species are often separated by a number of minor characters which are apt to disappear on drying, and, moreover, because the changes on drying are usually very considerable owing to the large percentage of water. The accompanying blank form will be found useful for these notes, together with small outline sketches of a specimen entire and in section to show its general shape and the relation of its principal parts. It is highly desirable to make also a photograph of the plant or a colored drawing, or both, if time permits; if not, color notes from a color chart, with an accompanying sketch, will be found exceedingly helpful. If one's time is very limited, the following characters should be given preference: the color and color changes of all parts, surface characters of pileus and stipe, form of the veil, taste of the flesh, and color of the spores as shown in a spore-print.

Dried specimens are absolutely necessary for scientific study. Drawings and field notes, no matter how artistic and complete, can never take the place of the plants themselves in the herbarium. Various devices have been used for drying fleshy fungi, the principle being to keep the specimens *continuously* in a current of hot air until *thoroughly* dry. A piece of wire netting suspended above a lamp or a stove forms a simple and efficient drying outfit, which may be enlarged as circumstances require. The dried specimens should be kept in tight boxes with camphor or naphthalene to keep out insect pests.

The determination of specimens is easier while they are fresh, but the collector is often compelled to defer the study of his collections until the winter season brings him more leisure. There are certain advantages in this delay, however, because of the array of specimens at hand at the same time for comparison and the combined experience of the entire season in becoming acquainted with variations and distinguishing characters. If one is

**NAME** .....

Locality, Date

Habitat

Habit

Size

**PILEUS** .....

Shape

Color

Changes

Surface

Margin

Veil

Annulus

**CONTEXT** .....

Consistency

Color

Changes

Odor, taste

**TUBES** .....

Attachment

Color

Changes

Mouths

Form

Spores

Print

**STIPE** .....

Attachment

Shape

Color

Changes

Surface

Substance

Changes

*Remarks* .....

near a botanical institution, he can also, perhaps, make use of a named collection and the literature bearing on the group.

The best single publication on the *Boleti* for field work and general use is Peck's "Boleti of the United States" (Bull. N. Y. State Mus. 2: 73-166, 1889), in which most of our common species are described and classified. Underwood's "Suggestions for the Study of the North American Boletaceae" (Contrib. Dept. Bot. Columbia Univ. No. 176, 1901), is a valuable supplement to Professor Peck's work, giving citations to literature and illustrations, a list of species known to date, and revised keys with species recently described incorporated. There are no descriptions, however, and the work can be used only in a supplementary way. Atkinson's "Studies of American Fungi" includes full descriptions of a limited number of *Boleti* common in the state of New York. McIlvaine's "One Thousand American Fungi" covers the group most fully, eighty pages being devoted to descriptions and illustrations of *Boleti*, mostly upon the authority of Professor Peck. The majority of the illustrations are, unfortunately, poorly executed and often misleading. The beginner is also warned against adopting too readily the author's ideas regarding certain species considered poisonous by most mycologists, as it is possible that the specimens experimented upon were not in all cases accurately determined. This is especially liable to be true in the case of European species said to occur in this country. No attempt is here made to discredit Captain McIlvaine's valuable work, but the suggestion is that the relation between European and American forms has not yet been satisfactorily determined, even by our best mycologists.

A correct and useful system of classification of the one hundred and fifty or more native species of *Boleti* is rather difficult to construct, with our present limited knowledge of many of the species. For the time being, it is probably best to divide the family into groups that are easily distinguishable, even though arbitrary in some cases, and let the collector record the group to which a plant belongs while it is still fresh. This will greatly facilitate the classification of specimens after they are dried, and will often take the place of valuable data omitted by the collector.

The chief characters used in this temporary grouping are the position of the stem, the habitat of the plant, the coherency, size, and arrangement of the tubes, the presence of a veil, viscid dots on tubes and stem, red mouths to the tubes, a lacerated and deeply-grooved stem, adnate or free tubes, a yellow powder covering the entire plant, and flesh-colored or blackish-brown spores.

The spores vary but little, considering the number of species, most of them being fusiform in shape and ochraceous-brown to ferruginous in color. Flesh-colored, pale-yellow, purplish-brown and blackish-brown spores occur, but they are exceptional. A greenish tint is noticed in the fresh spores of many species, but it usually disappears on drying.

Certain other characters, such as reticulations on the stem, viscosity, changes in color of flesh or tubes, and inconspicuous surface coverings, often vary with age, locality or the weather in some species, and may or may not be reliable, but may be conveniently used at times in connection with more important characters to distinguish certain groups.

A key to these provisional groups is given below, each group being designated by a letter. Well-known species have been used in the key as examples of various groups, as a means of ready identification and comparison.

#### GROUPS OF NORTH AMERICAN BOLETI

Tubes separated from each other; stem lateral; plants found on decaying stumps, trunks or roots. (*Fistulina hepatica.*) **A**

Tubes attached to each other; stem central, rarely eccentric; plants terrestrial, except in very rare instances.

Tubes arranged in radiating rows. (*Boletinus porosus.*) **B**

Tubes usually small, not arranged in radiating rows.

Pileus conspicuously floccose.

Spores blackish-brown. (*Strobilomyces strobilaceus.*) **C**

Spores ferruginous. (*Boletus Ananas.*) **D**

Pileus glabrous or subtomentose.

Stem annulate. (*Boletus luteus.*) **E**

Stem exannulate.

Stem and tubes glandular-dotted with a gummy secretion that hardens and turns black soon after exudation. (*Boletus granulatus.*) **F**

Stem shaggy and lacerate, with deep reticulated furrows; spores olive-brown. (*Boletus Russellii.*) **G**

- Stem hollow at maturity; spores pale-yellow, elliptical. (*Boletus castaneus*.) **H**
- Stem and pileus covered with a conspicuous sulphur-yellow powder. (*Boletus Ravenelii*.) **I**
- Not as above.
- Spores flesh-colored; tubes adnate, whitish, tinted by the spores at maturity. (*Boletus felleus*.) **J**
- Spores not flesh-colored, usually yellowish-brown.
- Tubes with red or reddish-brown mouths, yellowish within. (*Boletus purpureus*.) **K**
- Tubes not as above.
- Tubes free, white, not stuffed when young; stem not reticulated, often scabrous. (*Boletus scaber*.) **L**
- Tubes adnate, white or yellow, not stuffed when young.
- Stem reticulated. (*Boletus ornatipes*.) **M**
- Stem not reticulated. (*Boletus chrysenteron*.) **N**
- Not as above. (*Boletus edulis*.) **O**

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## SHORTER NOTES

JUNGERMANNIA IN NEW HAMPSHIRE. — All four species of the genus *Jungermannia* hitherto reported from New England have been collected by the writer at Waterville, New Hampshire, during 1906 and 1907. This, while a non-calcareous region, is well supplied with all the bryophytes to be expected there.

The commonest is *J. lanceolata* L., reported from all the New England States. By living on rocks or humus, it is independent of the underlying geological formations; but the other three are rock- and talus-growing plants, and avoid limestone at that. As *J. lanceolata* is unmistakable when fertile, it is herewith dismissed.

New Hampshire is the only state from which the subalpine *J. sphaerocarpa* Hook. is reported. It is found at Waterville on wet granite ledges, facing north, at 2,500 feet altitude, and with abundant perianths. It is a delicate plant, of a clear light-green, without much trace of purple; and it grew mixed with *Marsipella emarginata* (Ehrh.) Dum., *Lophozia alpestris* (Schleich.) Evans, etc.

The other two species were on granite rocks in Mad River, at



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