CLINTON, PECK AND FROST – THE DAWN OF NORTH AMERICAN BOLETOLOGY

Ernst E. Both
Buffalo Museum of Science, 1020 Humbolt Parkway, Buffalo, New York 14211
eboth@sciencebuff.org

and

Beatriz Ortiz-Santana
Center for Forest Mycology Research, US-Forest Service Northern Research Station
One Gifford Pinchot Drive, Madison, Wisconsin 53726
bortizsantana@fs.fed.us

ABSTRACT - George W. Clinton (a founder and first president of the Buffalo Society of Natural Sciences) launched the mycological career of Peck by obtaining for him the position of botanist of the New York State Cabinet of Natural History and he was responsible for the publication of Frost's "Boleti of New England." This paper discusses the interaction between Peck and Frost and presents the history of some of their taxa. A study of the type of *Boletus glutinosipes* Snell & Hesler (a taxon that has remained unknown since 1940) indicates that it is a synonym of *B. auriporus* Peck, while an examination of authentic material of *B. innixus* Frost demonstrates that *B. caespitosus* Peck is a synonym of it.

INTRODUCTION

In the first three decades of the 19th century, North American mycology was dominated by the works of Lewis David de Schweinitz (1780–1834) "the son of the head of the Moravian Church in the United States" (Figure 1). He was born in Bethlehem, Pennsylvania (baptized as Ludwig David von Schweinitz but using the other form of his name in his publications), educated there and in Saxony. He became the administrative head of his church in Salem, North Carolina, and Bethlehem (Rogers, 1981).

In 1822 the "Schriften der Naturforschenden Gesellschaft zu Leipzig" published his *Synopsis fungorum Carolinae superioris*, his personal list of fungi, containing 1,373 species of which 320 were new, arranged according to Schweinitz's own system. This publication contained four new species of boletes which were included in his family "Boletoides" comprising two genera: *Daedalea* and *Boletus*. His genus "*Boletus*" was subdivided into four sections: A. *Suilli*, B. *Boleti*, C. *Poriae*, and D. *Fistulina*. Rogers (1977) called this "the first considerable publication on American fungi."

Section *Suilli* represented the true boletes while section *Boleti* contained polypores. Schweinitz listed 15 European boletes and three new species: *Boletus alboater, B. betula* and *B. floccosus.* A fourth new species was *Agaricus rhodoxanthus*, now known as the "gilled bolete," = *Phylloporus rhodoxanthus.* Schweinitz wrote of it "elegant, calling to mind *Boletus subtomentosus*" (a European species he had collected), "deceiving the observer." It is now recognized that this taxon is related to a group of boletes which include *Boletus subtomentosus* (= the genus *Xerocomus*).

Ten years later Schweinitz published *Synopsis fungorum in America Boreali medium degentium* in the Transactions of the Philosophical Society, Philadelphia (1832), including the new species *Boletus pocono* and *Daedalea merulioides* (= *Boletinellus merulioides*).

In 1839 Miles Joseph Berkeley (1803–1889), a clergyman of the Church of England, began to describe fungi from the Americas, based on specimens and descriptions sent to him by a number of correspondents. One of these was Thomas Gibson Lea (1785–1844), whose "Catalogue of Plants" collected in the vicinity of Cincinnati, Ohio (published posthumously in 1849) included Berkeley's *Paxillus porosus* (= *Boletinellus merulioides*) (Both, 1993).

Figure 1 - Lewis David de Schweinitz. Source: Lloyd, Mycological Notes # 44. 1916

Moses Ashley Curtis (1808–1872) of North Carolina, also a clergyman and avid botanist, began a correspondence with Berkeley in 1846 that lasted until his death. They agreed to collaborate on the publication of North American fleshy fungi that Curtis would provide together with his notes with the authors to be listed as "Berkeley & Curtis." But in July 1848 Curtis wrote to Berkeley that he wished to publish some species under his own name, writing "my object in this is to put my name before the American Botanist as investigator and authority in Mycology." Berkeley agreed (Petersen, 1980).

In October 1848 Curtis wrote to Berkeley: "A few weeks since I sent a paper to Silliman's Journal [American Journal of Science] with ten new species of fungi." One of these was *Boletus ananus* [sic!] that Curtis had collected in South Carolina near Santee River, an area that his friend Ravenel frequented.

Henry William Ravenel (1814–1887) was another one of Berkeley's correspondents who sent him several species of boletes which appeared in the first paper of the planned "B. & C." collaboration in 1853: *Boletus conicus* Ravenel, *B. ravenelii* B. & C., *B. decipiens* B. & C., (collected by Ravenel), *B. hemichrysus* B. & C. (also collected by Ravenel), and *B. curtisii* Berkeley (collected by Curtis) (Both, 1993). In 1860 Berkeley published his "Outlines of British Fungology", which was used as a model by Frost and Peck.

Apparently Berkeley procrastinated in working on the fungi of North America project despite inquiries by Curtis. Finally the "Notices of North American fungi" appeared in 1972, after the death of Curtis, though Berkeley always credited him in these publications (Petersen, 1980). But by this time Peck had already published his first bolete paper and a new period of North American boletology was beginning.

CLINTON

George W. Clinton (1807–1885), a descendant of New York's leading families, was born in New York City, the youngest son of Governor DeWitt Clinton (Figure 2). He interrupted his studies of botany when his father died in 1828 and turned to study of laws (Haines, 1986). After practicing law in Albany and Canandaigua, he moved to Buffalo in 1836, served there as a district attorney in 1841, and mayor of the City of Buffalo in 1842. In 1854 he became a judge of the Superior Court of Buffalo, "later superseded by Supreme Court," holding this position until his retirement (Goodyear, 1994).

The Buffalo Society of Natural Sciences came into being at a meeting on November 21, 1861, when a constitution was adopted with a resolution that the above name should be adopted, the Society's object being "the promotion and study of natural sciences through the formation of a museum and library, the procurement of lectures, and by such other means as shall be desirable and efficient for that purpose" (Robertson and Barcellona, 1939).

At a meeting on December 5, 1861 Clinton was elected president, a position he held until 1881, "when he resigned … to edit the public papers of his great uncle George Clinton, the first governor of New York and vice-president (1805-1812) under presidents Jefferson and Madison (Haines, ibid.)" During his tenure as the Society's president he acquired

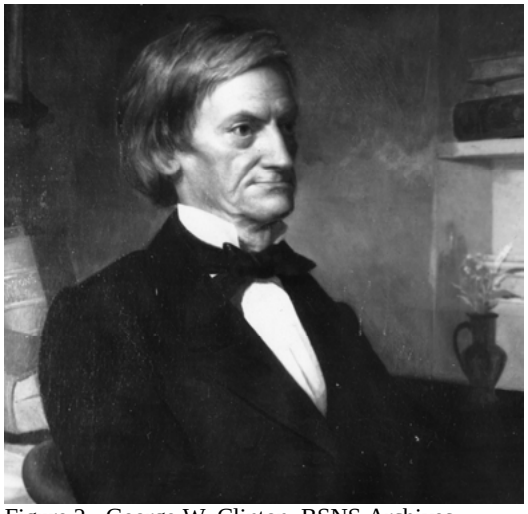
Figure 2 - George W. Clinton. BSNS Archives

considerable collections of botanical specimens. These and his own collections, which he donated to the Society, are housed in the Society's Clinton Herbarium (Goodyear, 1994).

PECK AND CLINTON

Charles Horton Peck (1833–1917) graduated from Union College in Schenectady with a degree of Bachelor of Arts in 1859 (Figure 3). In 1861 he married Mary Catherine Sliter and a year later he received the degree of Master of Arts from Union College and obtained a teaching position in the classics department of the State Street High School (known as "Cass' Academy") in Albany, a private school for boys (Haines, 1978).

At this time he became interested in mosses and within four years he had collected 144 species which he presented, together with a catalogue, to the State Cabinet of Natural History. The "Catalogue of Mosses presented to the State of New York by Charles H. Peck" was published in the Annual Report of the State Cabinet of Natural History 18:193–194. 1865. (Burnham, 1919).

In his spare time he worked as a volunteer in the herbarium of the State Cabinet. Late in 1867, he lost his teaching job when the Cass' Academy was closed and sold (Haines, 1978). In the same year Clinton, a Regent of the State University and a member of the Standing Committee of Regents charged with the care of the State Cabinet, secured for Peck the position of botanist of the State Cabinet for five years, a position that had to be renewed annually (Burnham, 1919). Clinton and Peck both shared a love of botany and they corresponded for many years. Nearly 500 letters from Peck to Clinton are preserved in the Archives of the Buffalo Society of Natural Sciences.

Within a year after his appointment as botanist, Peck became interested in fungi. He started to correspond with Elliot Calvin Howe (1828–1899) and Curtis, both of whom helped him with identification of his fungi.

Howe complained to Peck that Curtis "is too weak-headed to determine correctly, even well-marked species. He mixes things awfully" (26.XI.1868) and Howe was tempted to seek Ravenel's help. He wrote to Peck (14.XII.1868): "Yesterday, quite unexpectedly, I rec'd a long letter from Dr. Curtis… he gives the following unique & conclusive reply to my query about Ravenel's skill in mycology:" *As he comes to me for aid, I suppose I place myself somewhat in advance of him. With this admission, you may put him as among the best Mycologists, such as they are, in the U.S., although I believe there are no others who make any pretensions in this line.* Howe added: "He does not seem to reckon in Mr. Frost" (Petersen, 1980).

Curtis instructed Peck that he would give "precedence always to those who give me sketches of fructification with the specimens… I advised you… that you use the Microscope… you cannot become a Mycologist without a personal use of the lens" (23.V11.1869) (Petersen, 1980). Nearly a year later Curtis wrote to Peck "I see that you have a good eye for this work and a growing knowledge of the subject. If you chose, I think you can become our leading mycologist in a few years" (Peck's quote in a letter to Clinton, 4.IV.1870).

By 1869 Peck was ready to publish his first extensive mycological paper and he wrote to Clinton (8.XI.1869):

> I am getting quite thoroughly interested in the Agaricini and feel quite confident that we

> have many undescribed species. I have figured and described from fresh specimens nearly all that I have collected during the season… I purpose giving in my next report, unless you think it out of place, descriptions of all species, thus far found and investigated by me in their fresh state… Berkeley's Outlines, the only work in English that lays any claim to be a manual on these plants, come very far short of being complete or satisfactory in the study of our species. I believe such descriptions would add much to the value of the report.

In the report for 1868–69 (the 23rd Annual Report) Peck included descriptions of 173 species of 31 genera or subgenera of agarics (including 53 species new to science) and 19 species of *Boletus*, including these new species: *Boletus albus*, *B. auriporus*, *B. clintonianus*, *B. elbensis*, *B. paluster*, *B. pictus*, *B. spectabilis* and *B. vermiculosus*.

Boletus clintonianus was "dedicated to Hon. G.W. Clinton, than whom there is no more ardent lover of botany nor more devoted friend of science." *Boletus clintonianus* [as *Suillus clintonianus* (Peck) Kuntze, 1898] is generally treated as a synonym of *Suillus grevillei* Klotzsch, 1832 (or as a variety thereof) by most modern authors (Both, 1993). Korhonen et al. (1993) separated the two species on the basis of color, size of spores and other microscopic structures. They stated that "macroscopically, *Suillus clintonianus* is most easily distinguished from *S. grevillei* by its dark reddish-brown pileus," as Peck described it ("bay-red, or chestnut-color").

The 23rd Annual Report of the State Cabinet of Natural History was submitted to the Assembly of the State of New York on March 10, 1870. "On the 7th of April, 1871 the printing establishment of Weed, Parsons & Co. was destroyed by fire, together with the twenty-third Report on the State Cabinet" (Hall, 1873, p. 249), although a small number of pre-prints were available in March of 1871. A "botanical edition" was published in 1872, and the full report was issued in 1873. Thus Peck's "new species" should carry the date of 1872.

The British mycologist Mordecai Cubitt Cooke (1825–1914) extracted Peck's species from the 23rd Report and reprinted them in his journal "Grevillea" in 1872. Peck wrote to Clinton (8.XI.1872):

> I suspect one good thing has come from Cooke's extracts from the Report. It has probably waked up Berkeley, who, you will see, has at last begun publication of the species of B. and C. [Berkeley and Curtis] —a work which ought to have been done long ago and the neglect of which has caused me much perplexity and annoyance.

Shortly after the death of Curtis, Berkeley started a new series of "Notices of North American fungi" in the journal "Grevillea" (1872–1876), never failing to attribute new taxa to "B. & C." (Petersen, 1980, pp. 43 and 69). Among these were the following boletes (1872): *Boletus auriflammeus, B. murraii*, *B. retipes* and *B. spraguei*.

Figure 3 - Charles Horton Peck. BSNS Archives

With the end of his tenure as botanist approaching, Peck wrote to Clinton (10.XII.1872):

> The term of my own work, by the Law organizing the State Museum, will expire with the present fiscal year, and desirable as it may be to have it continued I suspect it will be a difficult matter; so many influences seem just now to be operating against us.

Some days later he wrote (c. 18.XII.1872):

> I scarcely know what to say, in answer to your request that I should let you know what my plans and wishes are and how you can serve me. My plans for work here were gathered mainly from you paper in relation there to… The question came up in the beginning, "how long do you want the appropriation for botanist." I said "five years," thinking that in that time I could approximate closely to the completion of the Herbarium… If now we should ask a longer continuance I fear they would say "you have had all the time you asked for it."

Once again it was Clinton's influence that secured continued funding for the position of botanist. Peck wrote to Clinton (13.II.1873):

> I have seen a copy of the Appropriation Bill… and I am pleased to say that the item for compensation of botanist is in all right. I confess I had some fears on this point, and cannot help feeling that this continuation is in great measure if not wholly due to your efforts. I want to thank you most heartily for such earnest and successful efforts in this matter.

In his presidential address of March 26, 1873 to the Buffalo Society of Natural Sciences Judge Clinton said:

> "We ought to commence giving our history and our proceedings to the scientific world at once. Until we do so, the Society can be as it is now, only partially recognized by our sister societies. Publication would give us a higher and more assured rank." (Robertson and Barcellona, 1939, p. 29).

The first volume of the Bulletin of the Buffalo Society of Natural Sciences was published in 1873. Peck contributed "Descriptions of New Species of Fungi" (read before the Society June 6, 1873) which included his *Boletus affinis*, *B. ampliporus*, *B. modestus* and *B. separans* (*B. affinis*, *B. modestus* and *B. separans* were simultaneously published in the 25th Annual Report on the State Museum in 1873, while *B. ampliporus* appeared in the 26th Report).

In the same paper Peck also published "*Boletus pallidus* Frost," almost exactly one year before Frost published it in the second volume of the Bulletin in 1874 (Both, 1993). Therein lays a strange tale! In August 1872 Peck collected a bolete that he believed to be a new species and he described it in his notebook (vol. 4, p.123) as *Boletus glaber* "near scaber" n. sp., the pileus "pallid or allutaceous,… viscid when moist,… tubes pale yellow, slightly changing color when bruised,… stem pallid," spores 10–12.5 × 5–6.25 µm. He commented that it "resembles *B. scaber* [*Leccinum scabrum*] but differs in its yellow, plane tubes and smooth stem." The description as published in the Bulletin is essentially the same.

In the 27th Report on the State Museum for 1873 (published 1875) Peck listed Frost as having contributed "*B. pallidus* Frost" and he was in possession of Frost's manuscript "Vermont Boleti" (letter to Clinton, 23.XII.1873) which contained a complete description of "*Boletus pallidus*, n. sp.," the same description that Frost published in 1874. Yet Peck chose to use his own description and simply attributed *Boletus pallidus* to Frost. Peck's collection is preserved at Albany, consisting of five well preserved specimens and a spore print, "North Greenbush, Rensselaer Co., N.Y. Ground in woods, August 1872, leg. Ch.H. Peck" (NYS!). The label reads "*Boletus pallidus* Frost in Peck, Bull. BSNS 1:60, 1873." As Both (1993) pointed out, this is the correct citation for this taxon, yet all works consulted cite it as "*Boletus pallidus* Frost, Bull. Buff. Soc. Nat. Sci. 2: 105. 1874." Peck (1889) provided another description based on Frost's published protologue without any reference to his own (1873) description.

FROST AND CLINTON

Charles Christopher Frost (1805–1880) "left the common school of Brattleboro, Vermont at age 14 because of an unjust beating administered by

his hot-tempered teacher" (Halling, 1983b) (Figure 4). For the rest of his life he pursued studies in nearly all the sciences, amassing a library of several hundred volumes. In 1831 he established his own business as a shoemaker and married Roxanna Sargent, after whom he named *Boletus roxanae* many years later (Dudley, 1886).

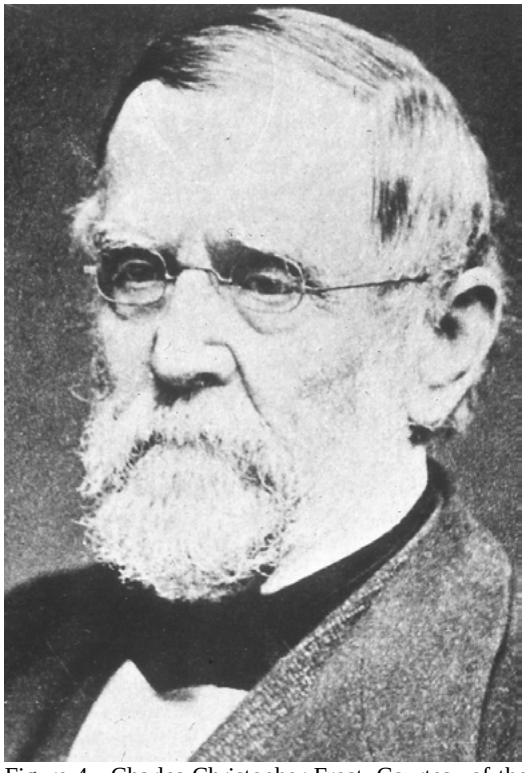

Figure 4 - Charles Christopher Frost. Courtesy of the New York Botanical Gardens

It is said that he became a botanist "through the advice of a noted New York physician, whom he consulted regarding a severe case of dyspepsia with which he was afflicted." The physician told him he should devote an hour each in the morning and afternoon to walking and to the study of plants on his walks (Murrill, 1908a).

Frost soon became interested in fungi which led to a friendship with Charles James Sprague (1823–1903). He purchased a microscope and began acquiring the necessary mycological library, including Fries' *Systema Mycologicum.* When he found out that it was written in Latin, "he immediately procured a Latin grammar and in six months taught himself enough Latin to be able to read it. In the same manner he taught himself German and French" (Duddley, 1886).

In 1860 Sprague gave Frost his manuscripts and encouraged him to continue the work on New England Fungi (Murrill, 1908a). Eight years later Frost sent Sprague a list of 33 boletes of which 19 bore Frost's name. In a letter accompanying this list (13.V.1868) Frost wrote: "*B. spraguei* should be my naming and the description with quotation marks as yours, as it was copied from your manuscript," (Halling, 1983a). All of Frost's species in this list appear with full description in an undated manuscript "Vermont Boleti" (c. 1871, at NYS) which, in addition, contained *Boletus frostii*, collected in 1871.

Sprague expressed his doubts concerning the validity of Frost's species in a letter to W.G. Farlow (1874):

> "As to his names I have much doubt. He has christened quite a number of fleshy fungi, but I fear that he has not sufficient material nor books and plates to warrant his doing this … I have always had great doubt as to the value of his new species… I don't think that his collections have that authentic value which might be possessed by some other authority" (Halling, 1983b).

Sprague seems to believe that only an established "authority" (such as Berkeley) was qualified to publish new species. Thus he sent his new species to Berkeley, rather than publish them himself.

Late in 1873 Clinton purchased the herbarium of John Lewis Russell (1808-1873), a friend of Frost's. It contained a number of boletes bearing Frost's names. Probably under apprehensions similar to those expressed by Sprague, Clinton turned to Peck for advice and help. Peck wrote to Clinton (23.XII.1873):

> I am not aware that Mr. Frost has published any descriptions of Boleti. He has however sent me manuscript descriptions of most species mentioned in your list and specimens of some. I doubt if I can do much with the

specimens but will do all I can if you are disposed to send them on.

The "manuscript descriptions" mentioned by Peck refers to Frost's manuscript "Vermont Boleti" and the species included Frost's *Boletus chromapes*, *B. miniato-olivaceus*, *B. pallidus*, *B. robustus*, *B. roxanae*, *B. rubeus*, *B. russelii*, *B. spraguei*, *B. speciosus*, *B. subchromeus* and *B. sordidus*. All of these were mentioned in the 27th Report (for 1873, published 1875) as having been contributed by Frost. Clinton then wrote to Frost and offered to publish his manuscript. Frost wrote to Clinton (29.I.1874):

Dear Sir

When I learned that you was the possessor of the Boleti I had once prepared, named and presented to the late Mr. Russell, and as they were my earlier collections, and I had found in later examinations some errors, I suspected that the collections I had made to him, might not have been known to you, therefore I desired you should be informed of them so as not be under any misapprehension. Also, since the distribution of those of my naming, others have succeeded in getting them before the public first; therefore the authority must be changed. I append a list as they should stand:

Boletus murraii B&C is B. pictus Peck
Boletus subchromeus Frost is B. ravenelii B&C
Boletus glutinipes Frost is B. auriporus Peck
Boletus aureo-brunneus is B. retipes B&C

In regard to my catalogue of Vermont Boleti I had purported to publish it in the "Archives of Science," a periodical of this State, as it would seem most proper to do so. But is has commence and failed twice and now another effort is being made to start again. If they do not succeed soon, your offer if not too late will be accepted and appreciated. I am much interested in the progress of the botanical survey of New York as it will so much advance the study of the cryptogamous plants of the whole country. In this specialty I consider Mr. Peck a wonder.

Please to pardon this seeming long delay to answer your kind letter far I have had a business to take care of in these panic times which required my most assiduous attention.

Yours respectfully,
Chas. C. Frost

Frost's "Catalogue of Boleti of New England, with Descriptions of New Species" was read before the Buffalo Society of Natural Sciences on June 5, 1874 and published the same year in volume 2 of the Society's Bulletin (Table 1).

This publication caused Rogers (1981) to write: "Frost is the first in his hemisphere who mastered that beautiful and exasperating family the Boletaceae."

THE HISTORIES OF SOME SPECIES OF PECK AND FROST

"A painstakingly detailed and unbiased reconstruction of the history of certain taxa and the role of mycologists involved in it would certainly put in perspective the progress thus far made in bolete taxonomy" (Singer, 1981).

Dr. Rolf Singer (1909–1994) was the first recipient of the Buffalo Society of Natural Sciences' "George W. Clinton Award for Life-long Achievement in the Natural Sciences" in 1986.

Table 1 A. Frost (1874); B. List sent to Sprague (1868) and "Vermont Boleti"; C. Herbarium Russell (BUF); D. Frost's boletes sent to Peck (House, 1914); E. Frostian boletes collected by Peck (unpublished notebooks).

A	B	C	D	E
chromapes	x	x	x	x
decorus				x
***ferrugineus* 1867**	x			
firmus				x
***frostii* 1871**			x	x
***innixus* 1866**	x	x		
***limatulus* 1869**				
magnisporus				
***miniato-olivaceus* 1863**	x		x	
pallidus	x		x	x
***robustus* = renamed: *eximius* Peck 1887**	x	x	x	x
***roxanae* 1866**	x	x	x	x
rubeus	x		x	x
***russellii* 1862**	x	x	x	x
***salmonicolor* 1862**			x	
***serotinus* 1862**	x	x		
sordidus	x	x	x	
***speciosus* 1868**	x	x	x	x
spraguei	x	x	x	x
tenuiculus				
viridarius				x
***viscosus* = renamed: *brevipes* Peck 1885**			x	x
***griseus* Frost in Peck 1878**			x	
***peckii* Frost in Peck 1878**			x	
***unicolor* Frost in Peck 1889**			x	

BOLETUS RETIPES, B. ORNATIPES AND *BOLETUS GRISEUS*

In 1869 Peck collected a bolete which he tentatively identified as *Boletus retipes*. In his notebook (vol. 2, p. 91) he described it as follows:

"*Boletus retipes* B. & C.? write to C" [Curtis] "Pileus thick, fleshy… smoothish, (minutely tomentose under a lens), pale van brown; flesh *yellow*, unchanching. Pores… bright indian yellow. Spores brownish ochraceous. Stipe… *yellow* and *venose-reticulated* its whole length. Remarkable for the yellow reticulated stipe."

He published an expanded description in the 23rd Report (1872) and added: "*B. retipes* is said to have the pileus yellow, and the stem reticulated nearly to the base —particulars which do not agree with our specimens. It is possible that future investigation may prove our plant to be a distinct species; but at present I prefer to consider it only a variety of the above mentioned species."

In 1870 he collected a bolete which he again believed to be *Boletus retipes* (notebook vol. 2, p. 174.):

"Pileus… smoothish or minutely sub-tomentose, grayish ochre. Flesh whitish, unchanging… stem… a little paler than the pileus… reticulated to or nearly to base. It is *retipes* except in color." Most likely, this was *Boletus griseus*.

In 1872 Berkeley published *Boletus retipes* B. & C. as follows:

"Pileus 1½ in. across, convex, dry, powdered with yellow; stem 2 in. high, ¼–½ in. thick…

reticulated to base, pulverulent downwards; pores yellow …pilei arising from a common base" (Both, 1993).

Peck collected a bolete in 1875 (notebook vol. 6:64) which he described as "*Boletus ornatipes* n. sp.," commenting "this species belongs to section *Calopodes* and appears to be near *B. retipes*, to which it was formerly referred, but from which it is distinct by its solitary habit, the absence of any pulverulence either of the pileus or stem, and its larger size. The tubes are yellow from the first, the stem is similarly colored but paler."

In 1978 Peck (29th Report for 1876) repeated his 1872 description of *Boletus retipes*, commenting "as soon as the characters of this species were published by Rev. M.J. Berkeley, it became evident that the plant I had referred to it and described … was distinct. There is no pulverulence to our plant nor does it have *pilei arising from a common base*. I would, therefore, give it the name *Boletus ornatipes*," (p. 67).

Peck did not designate a type of *B. ornatipes*, but since he repeated his 1872 description of *Boletus retipes*, this becomes the type of *B. ornatipes*. The situations is analogous to Frost's *Boletus robustus* which Peck (1887c) renamed *Boletus eximius*, since "*Boletus robustus* Frost 1874" is a later homonym of "*Boletus robustus* Fries 1851." As Halling (1983) pointed out, "a new name is typified by the type of the older name."

Frost apparently knew a bolete like *Boletus ornatipes* some years before Peck published it. A "*Boletus aureo-brunneus*" is in the list he sent to Sprague (1868) and a specimen of this was among the boletes he sent to Russell (Table 1). Peck annotated this specimen (at BUF): "I find no description of this in Frost's Ms. [= "Vermont Boleti"] and must leave it as is," while Frost in his letter to Clinton wrote (29.I.1874): "*Boletus aureo-brunneus* is *B. retipes* B. & C."

Murrill (1908b) indicated that in Frost's collection labeled "*Boletus edulis* Bull." there "is one poor specimen, which may be *B. edulis*, and a fine plant that is certainly *B. ornatipes*. In a letter to Professor Peck, dated Nov. 27, 1874, Frost says":

> Have you Curtis' full description of *Boletus retipes*? From all I can gather it seems to me that the specimen I sent you as such, is the true one. What you describe as such I suspect is a variety of *B. edulis*, it indeed does it exactly. If Bulliard's figure is the true species, then Sowerby's must be a variety, for they are very much unlike in appearance but microscopically they are the same species. What you describe is abundant here. Unless I greatly mistake, it is another variety of *Boletus edulis*. I am familiar with all three of them.

Murrill (ibid.) also reported that among a collection of "*Boletus felleus* Bull." by Frost there were five specimens which were "apparently *B. ornatipes*" while in a copy of his Catalogue [Frost's publication of 1874] presented to Mr. C.G. Pringle in 1876, this name [*Boletus retipes* B. & C.] is scratched out and replaced by *B. ornatipes* with the statement that "*B. retipes* is not a good Vermont species." Murrill also indicated that the unpublished "*Boletus aureo-brunneus* Frost is synonymous with *B. ornatipes* Peck." The three species (referred to by Frost in his letter to Peck, cited above) are *Boletus ornatipes*, *B. griseus* and *B. edulis* (sensu Frost). There is a collection in Albany (NYS!) marked "*Boletus edulis* Bull., Brattleboro Vt. C.C. Frost" that is clearly *B. ornatipes*.

In 1876 Frost sent Peck six specimens of fungi, one of which was "*Boletus griseus* n. sp." together with a description of it (Halling, 1983). Frost's contribution was acknowledged in the same report. Frost commented in his description: "This description answers the most common form [of *B. griseus*], yet there are others like it in every respect, except instead of white, the tubes, stem and flesh are intensely yellow, approaching *B. ornatipes*, Peck, in color."

Peck published "*Boletus griseus* Frost, n. sp." in the same report (p.45) but based it on a collection he made at Sand Lake, NY rather than Brattleboro, VT where Frost collected his specimen (Halling, 1983). Peck's collection was

made in August, 1875 and is described in his notebook (vol. 6, p. 66). The published protologue appears to be based in part on Frost's manuscript. Peck in his commentary stated "My esteemed friend, Mr. Frost, finds a form which he consider a variety of this species differing from the type in having the tubes flesh and stem yellow," (29th Report p. 45). Yet on p. 67 Peck wrote:

"Either this [*Boletus ornatipes*] or a closely related form is regarded by my friend Mr. C.C. Frost, as a variety of *B. griseus*, but the yellow flesh and the tubes, which are also yellow from the first, indicate to my mind a specific difference. It is by having respect to such a difference in color that the whole genus has been divided into primery series, and it hardly seems fitting to throw together, as varieties of one species, forms thus separated."

Some years later Peck (1889) returned to Frost's concept:

> "According to the Friesian arrangement, this species [*Boletus griseus*] should be excluded from this tribe [*Calopodes*] on account of the whitish color of the tubes, and yet it is so closely related to *Boletus ornatipes*, that it scarcely differs in any respect except color, and it might easily considered a mere variety of that species. Such instances of close relationships have led me to disregard the division of the genus into series based on the color of the tubes."

It was Frost who recognized that there were two, seemingly closely related species, but it was Peck who separated them completely. The confusion surrounding *Boletus retipes* and *B. ornatipes* continued well into the 20th Century (see Both, 1993 under these names). A number or authors treated *Boletus ornatipes* as a synonym of *B. retipes*, including Murrill (1910), Coker and Beers (1943), and Singer (1947).

Smith and Thiers (1971) rejected "the recent trend to consider *Boletus ornatipes* as a synonym of *B. retipes*," commenting that "we are inclined to accept Frost's idea of a close relationship" [of *B. griseus* and *B. ornatipes*] "but, with Peck, recognize both as distinct species." Singer (1986) separated the three species, retaining *Boletus retipes* in *Pulveroboletus*, while placing *B. griseus* and *B. ornatipes* in two different sections of *Boletus*.

Both (1993) echoed Frost's statement ("*Boletus retipes* is not a good Vermont species"), writing that *B. retipes* "has a southern distribution." Binder and Bresinsky (2002) sequenced the 25S rDNA from a number of isolates of *Boletus flavoniger*, *B. griseus*, *B. nigerrimus*, *B. ornatipes* and *B. retipes* and found that the latter was more widely distributed than *B. ornatipes* and that it was "limited to the southern part of Eastern North America," while *B. ornatipes*, though primarily northern in distribution, overlaps *B. retipes* in North Carolina.

Boletus flavoniger was described from Costa Rica (Halling and Mueller, 1999). Like *B. retipes* and *B. ornatipes* it contains "retipolides (novel macrocylic lactones) that are responsible for the intense color of the context" (Halling and Mueller, 2005, with a good color photograph).

Binder and Bresinsky (2002) created a new genus, *Retiboletus*, for "all retipolides producing fungi," which "form a natural and unique group within the *Boletaceae*," making five new combinations: *Retiboletus griseus* (Frost in Peck) Manfr. Binder & Bresinsky, *R. ornatipes* (Peck) Manfr. Binder & Bresinsky from northern Eastern North America, *Retiboletus retipes* (Berk. & M.A. Curtis) Manfr. Binder & Bresinsky from southern Eastern North America, *Retiboletus flavoniger* (Halling, G.M. Muell. & L.D. Gómez) Manfr. Binder & Bresinsky from Costa Rica, and *Retiboletus nigerrimus* (R. Heim) Manfr. Binder & Bresinsky from East Asia.

BOLETUS AURIPORUS AND *BOLETUS INNIXUS*

Peck published *Boletus auriporus* in 1872, characterized as follows: "Pileus dry, most minutely tomentose, grayish-brown sometimes tinged with red; tubes… bright golden yellow; stipe equal… smooth; flesh white, unchangeable… North Elba and New Baltimore." He did not record the size of the spores.

In 1885 he made a collection of *B. auriporus* (notebook vol. 14, p. 176) which he described briefly, giving the size of the spores as 10–12.5 × 5–6.25 and the stipe as "reddish, viscid when moist" [Peck's emphasis]. Four years later (Peck, 1889) provided a more expanded description with stem equal or slightly thickened at the base, "*viscid or glutinous when moist*" [emphasis his] "*especially toward the base*" [emphasis ours]. The spores were now said to be 7.25–10 × 4–5 µm. He added: "*Boletus glutinipes* Frost Ms. is not distinct."

Frost (Vermont Boleti, c. 1871) described the stem of *Boletus glutinipes* as "very glutinous at base," and the spores as "11.54 × 7.3 µm." In the same paper he described *Boletus innixus* with pileus "yellowish brown, slightly areolate when old …tubes lemon yellow …stem slender, short, very much thickened at the base …flesh whitish in pileus, brownish in stem" spores 10.54 × 7.3 µm. Frost added "the whole when old reclines as if for support" hence the name.

The spores of *B. auriporus*, as given by Peck in 1885 are close to being correct. Both (1998) in his study of the North Elba type found the spores to be 9.8–15.95 × 4–5.75 µm. It is difficult to understand why Peck in his 1889 publication gave the spores as 7.25–10 × 4–5 µm unless his collection was a mixture of *B. auriporus* and *B. innixus*. His description of the stem as "equal or slightly thickened at the base, viscid or glutinous… especially toward the base" would indicate *B. innixus*, which is especially characterized by a brownish, swollen to gourd-like basal area that does become very glutinous in wet weather (as Frost recognized: "stem… very much thickened at the base").

Murrill (1908b) commented "*B. innixus* is plainly an abnormal or distorted form of *B. auriporus* … the descriptions are practically identical and the type specimens of *B. innixus* show the characteristic yellow color of the tubes of *B. auriporus* still well preserved. The specimens united at the base suggest another synonym, *B. caespitosus* Peck." Murrill (1910) listed *Boletus innixus* and *B. caespitosus* as synonyms of *Ceriomyces auriporus* (Peck) Murrill.

Kallenbach (1935) rejected Murrill's synonymy and treated the closely related European *Boletus gentilis* (Quélet) Kallenbach as a synonym of *B. auriporus.* He reported the spores of *B. auriporus* as 10–13–20 × 4–6 µm, based on a specimen from Massachusetts.

Coker and Beers (1943) followed Murrill's synonymy. However, their description of *Boletus auriporus* appears to be a mixture of *B. auriporus* and *B. innixus*:

"Pileus glabrous to minutely felted, often… areolated … quite viscid in wet weather… tubes brilliant chrome yellow …stem with or without a strong swelling below the middle … brownish yellow above, brown below, quite viscid in wet weather [spores 8–11 × 3.7–4.2 µm]."

Their color painting (pl. 4. fig. 4) shows the swollen brown midportion of the stipe, characteristic of *B. innixus*, while the black-and-white photograph (pl. 3. lower right) shows a caespitose cluster of three, typical of *B. innixus*.

Snell (1945) in a note about *Boletus innixus* noted that "the fibrillose to possibly bunchy fibrillose surface" (of the pileus… suggests Frost's *Roxanae* "[*Boletus roxanae*], an observation echoed by Singer (1947): *Boletus innixus* Frost, thought, by some to be a synonym of *B. auriporus*, is hardly this species. The authentic specimens preserved here [at FH] would rather suggest a species close to *Boletus Roxanae* Peck" [should be Frost].

Table 2. Comparison of microscopic features – Souces: *Boletus auriporus* (type, Both 1998), *B. glutinosipes* (type, present study)), *B. glutinipes* (present study, ex herbario Russell, BUF), *B. caespitosus* (type, Smith & Thiers 1971), *B. innixus* (present study, Frost, authentic, ex herbario Russell (BUF) and *B. innixus* (present study, recent collection, Both 3543, BUF).

	Spores	Basidia	Cheilocystidia	Pleurocystidia
B. auriporus	9.8–15.95 × 3.96–5.75	30 × 12		35–55 × 7–16
B. glutinosipes	11.7–14.4 × 5–5.9	22.5–29.7 × 9–10	28.8–44.1 × 7.2–13.5	40.5–62 × 9–13.5
B. glutinipes	9–12.6 × 4.5–5.4	21.6–34.2 × 8.1–10	39.6–46.8 × 6.3–10.8	54–64.8 × 6.3–10
B. caespitosus	9–12 × 4–5	24–30 × 7–9		46–82 × 7–15
***B. innixus* (authentic)**	9–11.7 × 4–4.5	27–30.6 × 8.1–9	27.9–49.5 × 9–11.7	48.6–57.6 × 8.1–12.6
B. innixus	8.1–11.7 × 4–4.5	18–27.9 × 9–10	29.7–40.5 × 7.2–9	45–65.7 × 7.2–10

Singer did not discuss *B. innixus* further and did not connect it to *B. caespitosus*, of which he provided a complete description, based on the type, a specimen from Virginia, and one of the Coker's specimen [determined as *B. auriporus* at FH]. Singer also provided the first modern description of *B. auriporus*, but his concept included Murrill's *Boletus flavimarginatus* and Coker & Beers *B. viridiflavus*, which he treated as synonyms of *B. auriporus*.

Snell and Dick in their monograph (1970) did not include *Boletus innixus* but their description of *B. auriporus* [as *Pulveroboletus auriporus*] contains some elements that point to *B. innixus*, for example "stipe short, usually slender… sometimes thicker and ventricose… often brownish toward the base." Indeed their plate 30 (single specimen, center) shows a typical *Boletus innixus* [as *B. auriporus*] with the characteristic brown gourd-like base.

Smith and Thiers (1971) published a type of *Boletus caespitosus* Peck, but their description of *B. auriporus* also appears to include elements of *B. innixus*: "Pileus… surface sometimes areolate in age… stipe… equal or flared either above or below… pale yellow becoming brownish and darker below …spores 8–11 × 3.5–4.5 µm." Their description is based on two specimens.

In a footnote, Singer (1986, p. 774) wrote "*Boletus innixus* Frost = *B. auriporus* Peck sensu Coker & Beers = *B. caespitosus* Peck sensu Singer (1947)" without providing any details.

Weber and Smith (1985) published an excellent photograph of *Boletus auriporus* (p. 82, as *B. viridiflavus*) and one of *Boletus innixus* (pl. 83, as *B. caespitosus*).

Both (1998) published a type study of *Boletus auriporus* together with a detailed macromorphological description based on abundant collections and he placed *B. caespitosus* Peck in synonymy with *B. innixus* Frost and provided the first unambiguous description based on fresh collections (deposited at BUF) (see Table 2). Finally, Bessette, Roody and Bessette (2000) provided detailed descriptions of both species with excellent color photographs.

Snell and Hesler (in Snell, Smith & Hesler, 1940) published *Boletus glutinosipes* based on a single collection from Cades Cover, Great Smokey Mountains National Park in Tennessee. Its pileus was yellow-brown tinged olivaceous, streaked reddish-brown, with pallid, unchanging flesh and lemon-yellow to greenish yellow, unchanging tubes. The stipe was "glutinous most of its length, yellow furfuraceous at apex, pale reddish-brown in mid-

section, base white." Spores 10–14 × 4.5, "mostly 11–12 × 4.5 µm."

This taxon has not been reported since the day it was published and its taxonomic position is uncertain. The overall colors, unchanging flesh, glutinous stipe with furfuraceous apex and size of spores point to *Boletus auriporus*. We have studied the type and compare its microscopic structures with those of the type of *Boletus auriporus* (Both, 1998) (see Table 2). The type of *Boletus glutinosipes* at Maryland (BPI) consists of a single specimen (stipe not attached). Pileus 25 mm diam., pale yellowish brown (Methuen 4B5) to reddish brown (7F5), infested with mold at disc and near margin. Pore surface golden brown (5D6) to cinnamon brown (6D6), pores 0.5–1.5 mm, angular, tubes concolorous, ~4 mm long. Stipe 53 × 3–6 mm, concolorous with pileus, basal mycelium whitish; infested with mold at apex.

BOLETUS PICTUS

In 1869 Peck collected what he thought to be "*Boletus decipiens* B. & C." and under this name he described it in his notebook (vol. 2, p. 54). He published essentially the same description as "*Boletus pictus* n. sp." in the 23rd Report (1872) without any reference to *Boletus decipiens*. Palm and Stewart (1986) remarked "the entry in the notebook [under *B. decipiens*] is most probably the basis for the protologue of *B. pictus.*" There is no doubt Peck's description of "*Boletus decipiens*" is the basis for the protologue as our comparison of the two demonstrates (the description of *B. decipiens* is in italics):

Pileus convex… viscid when moist
Pileus broadly convex… viscid when moist
Covered with a red tomentum breaking into squamae
Covered with a red tomentum, which soon breaks up into rather small close scales
Pores plane or convex, attached, yellow, large, angular
Tubes plane or convex, attached, large, angular, yellow
Stipe firm, solid, subconcolorous, equal
Stipe equal, solid, subconcolorous

Palm and Stewart (ibid.) commented that "Peck also cited New Baltimore … at the end of the entry but apparently no collection was preserved." Actually, the entry referred to reads "New Baltim., S.L. etc." (New Baltimore, Sand Lake, etc.) indicating that Peck had observed it in several locations.

Years later Peck (1889) transferred *Boletus decipiens* to *Boletinus*, listing its distribution as "North and South Carolina," commenting that "specimens of this species have not seen by me."

In 1856 Sprague collected a bolete together with a description which Berkeley (1872) published as *Boletus spraguei* B. & C., some months after Peck had published *B. pictus.* The description was published by Palm and Stewart (1986) and reveals Sprague as having been a very astute observer. It is far more detailed than the early descriptions by Peck. At the same time Sprague sent Berkeley another bolete which was published as *Boletus murrayi* B. & C. as follows:

"Pileus 2¾ in. across, nearly 1½ in. thick, vivid red, granulated; flesh yellow; stem clavate, yellow, even: pores about a line deep, decurrent; yellow. Spores as in *B. castaneus*, pale yellow."

Palm and Stewart (ibid.) commented that "the description accompanying the holotype (K) is probably based on immature material. No mention is made of the presence of velar tissue or of red fibrils on the stipe as are characteristic of *B. pictus.*" They made *B. pictus* and *B. murrayi* synonyms of *B. spraguei* B. & C. in Berkeley *nec B. spraguei* Frost, 1874.

Sprague had a complete description of *B. murrayi* in the manuscript he gave to Frost, who repeated this description as "*Boletus murraii* [sic!] Sprague's Mss" in his manuscript "Vermont Boleti" as follows:

"*Pileus* flat convex, thick with a firm elastic flesh, same color as the stipe when cut, color drab yellow below, but it is covered with a beautiful crimson webbing distributed in blotches all over. *Veil* covering the pores in youth white yellow, disappearing early and leaving a scar at the top of the stem and adhering for a time to the margin of the pileus in a kind of ring appressed to the pores. *Tubes* ginger yellow, large, with angular mouths not separable

from each other. *Stem* smooth or wooly scurfy, stained with reddish blotches on a yellow ground, upper portion reticulated slightly, solid flesh, light drab, turning purplish when cut, generally flexuous and bulbous at base. Flesh yellowish, spores ochraceous. Length .0054. Thickness .0035 millimeters. In damp pine woods, Aug. to Sept."

Frost (1874) in a footnote under "*Boletus pictus*, Peck" wrote "This species was discovered several years since by the late Mr. Dennis Murray, of Roxbury, Mass. and named *Boletus Murraii* [sic!] B. & C. (C.J. Sprague's MSS). Under this name I have distributed it. Recently it has been published in the "Grevillea" a London periodical, as *Boletus Spragueii* [sic!] B. & C. Mr. Peck, of the New York botanical survey, several months before this latter, published it as *Boletus pictus*, Peck, therefore his name has priority."

However, as Palm and Stewart pointed out, "the name *Boletus pictus* Peck (1872) is illegitimate and must be rejected because it is later homonym of *Boletus pictus* Schultz (1806)." Regrettable they did not publish the description of *Boletus murrayi* preserved at K, because the description of *B. murrayi* in Frost's "Vermont Boleti" is practically identical with the description of Sprague's (of *Boletus spraguei*) they published, indicating that Frost's statement, cited above, may be correct (i.e. that *B. murrayi* was published as *B. spraguei*).

BOLETUS PECKII

In 1875 Peck collected what he thought to be a new species. In his notebook (vol. 6, p. 51) he wrote "*Boletus pulcherripes* Pk. n. sp." underneath he wrote "Ground in woods S.L. [Sand Lake] Aug." As he began to describe it he apparently changed his mind and crossed out "*pulcherripes*" and wrote above it [in pencil] "*speciosus* Frost" leaving "Pk. n. sp." Next he wrote:

> "In our specimens the pileus fades with age and in drying to a brownish-buff, and the stems are yellow only at the top, the rest being usually a brighter and more permanent red than the pileus. They are rather smaller than the type, but scarcely more than a variety I think. They differ from *B. bicolor* in the expallent pileus and reticulated stem."

The underlined sentence would indicate that Peck thought he was dealing with a variety of Frost's *Boletus speciosus*. He then erased "*speciosus*" ["speciosus" is still legible under a lens] and wrote over it "Peckii," thus creating "*Boletus Peckii* Frost." The sentence underlined is crossed out and on the margin of the page Peck wrote: "place after the first of the next page" (see also Both, 1993).

On the next page (vol. 6, p. 52) Peck provided a complete description that closely parallels the published protologue under "BOLETUS PECKII Frost n. sp." (29th Report p. 45, 1878). It omits the passage cited above. In the commentary Peck wrote: "The stem is generally brighter colored than the pileus and retains its color longer. The species should be referred to the *Calopodes*." In his monograph (Peck, 1889) he added "The species is allied to *Boletus calopus* Fr., from which it is separated by its red expallent pileus, its stem yellow at the top and by its longer spores." Frost, Vermont is not listed in the distribution.

The type at Albany (NYS!) consists of 17 specimens, some well preserved, and others in parts. A colored drawing shows two specimens, the largest with a pileus 62 mm wide, stipe 50 × 10 mm, the stipes almost entirely red except for the yellow apex, the reticulum with elongated wide meshes.

Table 3. Comparison of *B. peckii* and *B. bicolor*. Source: Smith and Thiers (1971).

	***B. peckii* (type)**	***B. bicolor* (type)**	***B. bicolor***
Spores	9–12 (13) × 3.5–5	10–13 × 3.5–5	8–11 (12) × 3.5–4.5 (5)
Basidia	26–35 × 8–10	× 8–10	26–34 × 7–8
Cystidia	28–37 × 7–12	30–40 × 8–12	(20) 35–50 × 7–12

Murrill (1908b) in his examination of Frost's boletes in the Frost Herbarium at the University of Vermont wrote that *Boletus peckii* "does not appear in the collection." Neither are "original Frostian specimens of *Boletus peckii* … deposited in herbaria with his other specimens" (Halling, 1983a). It is possible that Frost, in the spirit of collegiality permitted Peck to attribute his species to Frost, similar to Frost's attributing *Boletus frostii* to his friend Russell. But evidence is lacking.

It is interesting that Peck compared *Boletus peckii* to *B. bicolor* —they both share red pilei fading to brownish in age, short tubes (5–8 mm) and similar sizes in their microscopic structures (see Table 3).

BOLETUS FIRMUS

Frost (1874) provided a brief description of his *Boletus firmus* which, despite its brevity, included the main characters; "Pileus… very firm, gray, slightly tomentose …tubes yellow, mouths tinged red …stem solid, hard, yellowish, reddish at base. Spores 12.5 × 3.2." Frost commented: "A readily distinguished species from its tenacity and generally distorted growth."

Peck (notebook vol. 19, p. 74. 1895/6) commented on a collection of *B. firmus* he made that had spores 12.5 × 6.25 µm but that "in the plant as described by Frost they are as given .00012 in. [= 3.0 µm] broad. This is probably a mistake as it is narrower than any other species known to me and as our plant agrees in all other respects with the description." However, the spores of *B. firmus* are indeed as narrow as given by Frost, 3.4–4.5 µm (Halling, 1983a). Peck must have been dealing with a different species.

A somewhat expanded description was provided by Peck (1889). Murrill (1910) listed it as a synonym of *Suillelus luridus* (Schaeff.) Murrill (= *Boletus luridus*).

It remained unreported in the literature over 30 years until Krieger (1936) reported on a collection from Canada, commenting on its gray pileus and very fine yellow reticulum of its stipe (no other details were provided).

Coker and Beers (1943) published their *Boletus satanas* var. *americanus* as a new variety – they did not include Frost's species in their book. Singer (1947) commented on Coker & Beers' taxon, saying "probably not a variety of *Boletus satanas* but some other species of section Luridi." Singer made no connection between *Boletus firmus* and Coker & Beers' taxon, but he did mention Krieger's statement that the pileus of Frost's taxon was gray.

Dick (1960) thought that she had collected it in Connecticut but her description is quite at variance with Frost's and the spores of her material were shorter (Halling, 1983a). Snell and Dick (1970) published a description and color plate of Dick's material as *Boletus firmus* that is "most certainty *B. fagicola*" (Both, 1993). Smith and Thiers (1971) published their *Boletus fagicola*, stating that "this species passed as *B. firmus* in Michigan for many years, but Frost's original description rules against the identification." "We suspect the 'distorted growth' to indicate the species may have been described from basidiocarps with a systemic infection of some Ascomycete, possibly a Hypomyces."

Later the same year Grand and Smith (1971) published *Boletus piedmontensis* as a new species, originally identified as *B. satanas* var. *americanus* but since the type appeared to be lost and since they found some discrepancies between the two taxa they erected a new species. They reported on "lens-shaped amyloid particles within the cuticular hyphae of the pileus," a unique and diagnostic feature for this taxon. They did not make any connection between their taxon and Frost's.

Table 4. Comparison of *Boletus firmus*, *B. piedmontesis* and *B. manicus*. Sources: A. Type of *Boletus firmus* from Vermont (Halling, 1983); B. Type of *Boletus piedmontesis* from North Carolina (Grand & Smith, 1971); C. *Boletus firmus* from Costa Rica (Halling & Mueller, 1999); D. *Boletus firmus* from Belize (Ortiz-Santana et al., 2007); E. *Boletus manicus* from New Guinea (Corner, 1972).

	A	**B**	**C**	**D**	**E**
Spores	(8.4) 10–12.6 × (2.8) 3.4–4.6 (5)	9–12 × 3.5–5	9.8–11.9 × 4.2–4.9	(8.8) 10.4–12.8 × 4.8–5.6	9–11.6 (13.5) × 4–5
Basidia	22–30 × 8–10	20–28 × 7–10	33–38 × 7–11	18.4–30.4 × 9.6	25–30 × 13–15
Pleurocystidia	30–55 × 5–10	33–52 × 9–14	20–30 × 5–7	40–54.4 × 7.2–8	–30 × 5–9

Singer (1977) in his bolete keyes listed *Boletus firmus* next to *B. fagicola* (probably based on the comment of Smith & Thiers) and he keyed out *B. piedmontensis* some distance away from *B. firmus*, without making a connection between the two.

Grand and Lodge (1978) located the type of Coker & Beers' taxon and found the "amyloid bodies" in the cuticular hyphae of the pileus. Since Coker & Beers did not validly publish "*B. satanas* var. *americanus*" (according to the rules of nomenclature) "*B. piedmontensis* remains the legitimate name." They too did not make any connection to *B. firmus.*

Halling (1983a) published a study of the type of *Boletus firmus* and like the authors before him failed to make a connection between Frost's species and *Boletus piedmontensis*. He commented on a specimen (at FH) that it had "a distorted hymenophore" but that it was not parasitized.

Based on our observations on 10 collections from western New York (at BUF), the "distorted growth" mentioned by Frost may refer to several features: The margin of the pileus is strongly incurved and wavy; the surface of the pileus is often uneven, at times pitted or roughened; the pore surface is often pitted or distorted; the stipe is frequently curved, to elongate S-shaped. We have not observed any infection with *Hypomyces.*

Both (1993) indicated that *B. piedmontensis* and *B. satanas* var. *americanus* were the same as *B. firmus*, writing "the overall color scheme, the nearly identical microscopic features as reported by Grand and Smith for *B. piedmontensis* and by Halling (1983a) for the lectotype of *B. firmus* make it clear that these two taxa are the same. Thus *B. piedmontensis* should be regarded as a synonym of *B. firmus*."

Both (ibid.) also indicated that *Boletus manicus* Heim, described from New Guinea, "appears to be a closely related species [if not identical]." Corner (1972) provided a detailed description of it but did not relate it to *B. firmus*.

Halling and Mueller (1999) reported *Boletus firmus* from the Cordillera Guanacaste in Costa Rica, while Ortiz-Santana et al. (2007) found it in Belize. The collections from Costa Rica and Belize also showed the diagnostic "amyloid particles in the cuticular hyphae of the pileus." (See Table 4).

CONCLUSIONS

In a letter to Clinton (4.II.1871) Peck wrote:

> "The editors of the American Journal also decline to publish the descriptions of fungi giving as reasons that their pages are already filled for some months ahead and that they have reason to believe that they will have an abundance of articles more interesting than mere dry descriptions."

As State Botanist Peck had the great advantage to publish his new species in a regular and timely fashion in his annual reports. On the other hand this advantage was offset by the fact that these publications did not usually reach the general public or the non-professional mycologists. For example, his monograph of the "Boleti of the United States" (1889) was rarely cited in the more popular literature, nor was it widely used (if used at all) by non-professionals.

Frost could have published his "Vermont Boleti" as early as 1869/70 but he did not have the right outlet for it. His final manuscript "Boleti of New England," might not have been published at all were it not for Clinton and his purchase of Russell's herbarium.

On the other hand it was Peck's generosity that led to the publication of Frost's *Boletus griseus* and his *B. unicolor* (posthumously) and Peck's attribution of his own *B. peckii* to Frost. Peck explained: "Frost gave names to those which he considered new species, and it gives me pleasure to adopt his names whenever it is rendered possible by the discovery of the species within our limits," (Peck, 1887). There is no question that Frost and Peck influenced each other, but it was Clinton who brought them together and who was instrumental in advancing their mycological careers.

Peck and Frost adopted Berkeley's system of classification implicitly, thereby initiating a systematic approach in dealing with the boletes, and laying the foundation of North American boletology.

ACKNOWLEDGMENTS

The senior author thanks John Haines for access to Peck's types and unpolished notebooks, and to Roy Halling for copies of his notes on Frost and copies of Frost's unpublished manuscripts. We are grateful to Drs. Ronald H. Petersen (TENN-herbarium) and Amy Y. Rossman (BPI-herbarium) for their assistance with the loan of *Boletus glutinosipes*.

REFERENCES

Bessette, A.E., Roody W.C. and Bessette, A.R. 2000. North American boletes: a color guide to the fleshy pore mushrooms. Syracuse University Press. pp. 396.

Berkeley, M.J. 1860. Outlines of British Fungology. L. Reeve and H. Street, Covent Garden, London. pp. 442.

Berkeley, M.J. 1872. Notices of North American fungi. *Grevillea* 1, 33–39.

Binder, M. and Bresinsky, A. 2002. *Retiboletus*, a new genus for a species-complex in the Boletaceae producing retipolides. Feddes Repertorium 113 (1–2), 30–40.

Both, E.E. 1993. The Boletes of North America. A compendium. Buffalo Museum of Science, Buffalo, New York. pp. 436.

Both, E.E. 1998. Two boletes with identity problems. *Bulletin of the Buffalo Society of Natural Sciences* 36, 226–232.

Burnham, S.H. 1919. Charles Horton Peck. *Mycologia* 11, 33–39.

Coker, W.C. and Beers, A.H. 1943. The Boletaceae of North Carolina. The University of North Carolina Press, Chapel Hill, North Carolina, pp. 91.

Corner, E.J.H. 1972. Boletus in Malaysia. The Botanic Gardens, Singapore. pp 236.

Dick, E.A. 1960. Notes on Boletes XII. *Mycologia* 52, 130–136.

Dudley, W.R. 1886. Charles Christopher Frost. *Journal of Mycology* 2, 114–118.

Frost, C.C. c. 1871. Vermont Boleti. Catalogue of the Boleti of Vermont with descriptions of new species. Manuscript at NYS.

Frost, C.C. 1874. Catalogue of boleti of New England, with descriptions of new species. *Bulletin of the Buffalo Society of Natural Sciences* 2, 100–105.

Frost, C.C. c. 1874. Notices on some new species of New England fungi. Manuscript at NYS.

Goodyear, G.F. 1994. Society and Museum. A History of the Buffalo Society of Natural Sciences 1861–1993 and the Buffalo Museum of Science 1928–1993. *Bulletin of the Buffalo Society of Natural Sciences* 34, 20, 160.

Grand, L.F. and Smith A.H. 1971. A previously unrecognized southern species of *Boletus*. *Mycologia* 63, 114–117.

Grand, L.F. and Lodge, D.J. 1978. Occurrence of *Boletus piedmontensis* in North Carolina and Georgia. *Mycologia* 70, 1267–1268.

Haines, J.H. 1978. Charles Horton Peck. *McIlvainea* 3(2), 3–9.

Haines, J.H. 1986. Charles Peck and his contribution to American mycology. Mycotaxon 26, 17–27.

Hall, J. 1873. Reply to a "Note on a question of priority." *Annual Report of the New York State Cabinet of Natural History* 23, 249.

Halling, R.E. 1983a. Boletes described by Charles C. Frost. *Mycologia* 75, 70–92.

Halling, R.E. 1983b. Charles Frost, boletologist from Brattleboro. *Boston Mycological Club Bulletin* 38(3), 7–9.

Halling, R.E. and Mueller, G.M. 1999. New Boletes from Costa Rica. *Mycologia* 91, 893–899.

Halling, R.E. and Mueller, G.M. 2005. Common mushrooms of the Talamanca Mountains, Costa Rica. The New York Botanical Garden, pp. 195.

House, H.D. 1914. "The Frost Boleti" sent to Dr. Peck, from C.C. Frost, Brattleboro, Vt. Typed manuscript, pp. 6 (NYS!).

Kallenbach, F. 1935. Die Roehrlinge (Boletaceae). 14. Lieferung, 96–100. Verlag von Dr. Werner Klinkhardt, Leipzig, Germany.

Korhonen, M., Hyvönen, J. and Ahti, T. 1993. *Suillus grevillei* and *S. clintonianus* (Gomphidiaceae), two boletoid fungi associated with Larix. *Karstenia* 33, 1–9.

Krieger, L.C.C. 1936. The Mushroom Handbook. The Macmillan Company, New York. pp. 560.

Murrill, W.A. 1908a. Notes on the life and work of Charles C. Frost. *Torreya* 8, 197–200.

Murrill, W.A. 1908b. The boleti of the Frost herbarium. *Bulletin of the Torrey Botanical Club* 35, 517–526.

Murrill, W.A. 1910. Boletaceae. North American Flora. *The New York Botanical Garden* 9(3), 133–161.

Ortiz-Santana, B., Lodge, D.J., Baroni, T.J, and Both, E.E. 2007. Boletes from Belize and the Dominican Republic. *Fungal Diversity* 27, 298–300.

Palm, M.E. and Stewart, E.L. 1986. Typification and nomenclature of selected *Suillus* species. *Mycologia* 78, 325–333.

Peck, C.H. 1872 (Preprint). Genus Boletus Fr. 23rd Report on the New York. State Cabinet of Natural History. 127–133.

Peck, C.H. 1873. Descriptions of new species of fungi. *Bulletin of the Buffalo Society of Natural Sciences* 1, 41–72.

Peck, C.H. 1878. 29th Report of the State botanis. *Annual Report of the New York State Museum* 29, 29–82.

Peck, C.H. 1887a. "New species of New York." *Bulletin of the New York State Museum of Natural History* 1(2), pp. 5–24.

Peck, C.H. 1887b. New York species of viscid bolete. *Bulletin of the New York State Museum* 1(2), 60–62.

Peck, C.H. 1887c. Notes on the boleti of the United States. *Journal of Mycology* 3, 53–55.

Peck, C.H. 1889. Boleti of the United States. Bulletin of the New York State Museum 2(8), 73–166.

Petersen, R.H. 1980. "B. & C.": The mycological association of M.J. Berkeley and M.A. Curtis. Bibliotheca Mycologica Band 72. J. Cramer, Vaduz, Germany, pp. 120.

Robertson, I.C. and Barcellona, E.C. 1939. Seventy-five Years. A History of the Buffalo Society of Natural Sciences 1861-1936. *Bulletin of the Buffalo Society of Natural Sciences* 18, 29.

Rogers, D.P. 1977. L.D. de Schweinitz and early American mycology. Mycologia 69(2), 223–245.

Rogers, D.P. 1981. A brief history of mycology in North America. Augmented edition. Mycological Society of America. pp. 120.

Singer, R. 1947. The Boletoideae of Florida. The Boletineae of Florida with notes on extralimital species III. *The American Midland Naturalist* 37, 12–18, 84.

Singer, R. 1977. Keys for the identification of the species of Agaricales I. *Sydowia* 30, 192–279.

Singer, R. 1981. Notes on bolete taxonomy-III. *Persoonia* 11(3), 294.

Singer, R. 1986. The Agaricales in modern taxonomy. Koeltz Scientific Books, Koenigstein, Germany. pp. 981.

Smith, A.H. and H.D. Thiers. 1971. The Boletes of Michigan. University of Michigan Press, Ann Arbor. pp 428.

Snell, W.H. 1945. Notes on boletes. VII. Mycologia 37(3), 374–388.

Snell, W.H. and Dick, E.A. 1970. The boleti of Northeastern North America. J. Cramer, Lehre, Germany.

Snell, W.H., Smith, A.H. and Hesler, L.R. 1940. New species of boletes from Cades Cove in the Great Smokies. *Journal of the Elisha Mitchell Scientific Society* 56, 325–328.

Weber, N.S. and Smith, A.H. 1985. A field guide to southern mushrooms. University of Michigan Press, Ann Arbor, Michigan. pp. 280.