

base of the Paleozoic rocks in the Range Region of Arizona is the pre-Tonto, and not the pre-Unkar, unconformity of the Grand Canyon.

The Tonto sandstone (Cambrian) of the Grand Canyon is probably the equivalent of the Apache group in the Globe District, of the Colorado quartzite in the Clifton District, and, without much question, of the Bolsa quartzite of the Bisbee District. The Tonto shale of the Grand Canyon section apparently becomes more calcareous to the south and is correlated with the Abrigo limestone of Bisbee. Both carry middle Cambrian faunas, according to Mr. Walcott. Neither Ordovician nor Silurian is known in the Grand Canyon, nor at Globe nor Bisbee. Mr. Lindgren, however, has found Ordovician at Clifton and some beds of this period may possibly occur in the lower part of the Globe limestone, which is chiefly Devonian and Pennsylvanian. The persistence of the comparatively thin Devonian from the northern to the southern boundary of Arizona is rather remarkable in view of the fact that in the Grand Canyon the Devonian Temple Butte limestone is seldom over 100 feet thick, is lacking in some places and is bounded above and below by unconformities. At Bisbee, the Devonian Martin limestone is about 350 feet thick. The Mississippian and Pennsylvanian limestones are both strongly developed at the Grand Canyon and at Bisbee, but the Pennsylvanian has not been found at Clifton. At Globe only Pennsylvanian fossils have been found but between the Devonian and Pennsylvanian horizons are a few hundred feet of apparently conformable limestones which may in future yield Mississippian fossils.

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DISCUSSION AND CORRESPONDENCE

A BETTER METHOD OF PREPARING HERBARIUM SPECIMENS

MODERN critical study and exacting taxonomic methods require to-day more abundant and better-prepared herbarium specimens.

These must be made by specialists for specialists. The private herbarium can no longer be maintained, and the training we give students must be such as will fit them to do the work the well-organized educational or research institutions demand.

Mere illustrative material in elementary botany beginners should collect in great abundance—the profit of their course of instruction depending largely on their assiduity manifest in getting and studying judiciously selected specimens, including, of course, careful observation of the environment and the conditions under which the plants occur. This work, in fact, serves well as a preparation or training for collecting and preparing good herbarium specimens. The better knowledge one possesses the better collector he may be. Supposing, however, that the collecting has been properly done and the specimens ready to go in press, we will now concern ourselves with the *modus operandi* of drying.

The old method of using “dryers” to take up the moisture, substituting dry sheets of the absorbent paper for the moist ones after ten to twenty-four hours, repeating the operation continuously for at least the larger part of a week, is unsatisfactory for two distinct reasons. First, too much labor is required and too much time is consumed; second, many of the specimens do not become dry quickly enough and therefore lose the fresh life-like appearance and natural color which quick drying generally secures. A better method will reduce the labor, shorten the time, and almost or quite invariably ensure better results.

Such a method is dependent on an altogether different principle, namely, removing the moisture by a current of dry warm air instead of absorbing it by bibulous paper and then promptly removing the latter. It is extremely easy of execution. The ordinary slat press may be used—the sides, however, may be plane boards, or stiff cloth-board, if that is preferred. The pressure is secured by straps or cords in the usual way.

In place of the “dryers,” or rather alternating with these, *corrugated straw boards* are used. The rolls of such paper, usually found

in the wholesale paper stores, have corrugations on one side only. After being cut the usual size, twelve by eighteen inches, they should be glued two and two, so that each piece would then present corrugations on both exposed sides—the corrugations running crosswise, not lengthwise.

To fill the press, proceed as follows: Place on the work-table one side of the press, and on it lay a sheet of thick soft paper, or the ordinary "dryer" sheet may be used. On this put the thin species-sheet, on or in which the prepared specimen has been placed; then cover with a corrugated board. On the latter a specimen would be laid as in the beginning, again add a soft sheet or "dryer"; finally another corrugated board; and so on until all the specimens have been inserted.

If the pile is six to eight inches high, or even higher, all the better. After strapping the press properly, suspend it over the stove or other form of heater. The rising warm air will pass freely by the corrugations and quickly carry the moisture from the specimens.

The next day remove the specimens, when ready to put in others freshly collected. If leaves or stems are succulent, or if there are berries or other fruits containing very much moisture, five or six hours' drying will scarcely suffice, as it will in case of ordinary specimens; in that event, they would be allowed to remain in the press longer.

In a few stubborn cases it is not possible to arrange twigs, leaves or flowers to best advantage until they have lost some of their moisture. It would be well to place such occasional specimens in the old-fashioned press, or between "dryers" under some pressure for a short time, possibly over night; and then transfer them to the warm-air press to be quickly completed for the herbarium.

It is desirable to have the rope, which is used to suspend the press over the heater, follow the upper edge but *pass under the two straps* or cords that secure the press and furnish the pressure on the specimens; the weight of the packet itself will then continue the necessary pressure—which otherwise the shrinkage by loss of moisture would tend to lessen. If the press is set on the hot register

or radiator, or on an iron support over a heater, it will be desirable to have a short spring inserted in each of the straps, so that the slack will be promptly and effectually taken up as the drying proceeds.

If a small oil stove or a lantern is used to induce the current of warm air—usually the case when one is off on an extended expedition—it is quite necessary to have the press three feet or more above the heater. Then a piece of canvas or thick muslin, a yard wide, must be drawn around the press closely, hanging down so as to form a chute or sleeve to properly direct the warmed air.

The "soft" sheet separating the two specimens that are between each two corrugated boards, might be the ordinary "dryers" used in the old-style press, as signified above, provided, however, that they are not hard or firm. It is very desirable to have something *easily indented* by thick parts, otherwise they will injuriously press into the corrugated boards. The Riker Company, that first made this kind of press furnished a layer of cotton batting for the *soft* intermediate sheet; but it does not prove satisfactory on continued use. Somewhat similar material, perhaps that which is delicately faced, "dress wadding," might be entirely satisfactory. I confess that I myself have not yet passed the experimental stage touching this part of the work.

The suggestion that specimens dried so quickly and thoroughly would be exceedingly brittle does not seem to have proved true; but even if that should be the case, the specimens are much improved in this respect by following Dr. Millspaugh's method of poisoning, namely, by using some glycerine in the corrosive-sublimate solution. After use in the tropics in making an enormous number of herbarium specimens, I can say that the principle embodied in this plant-press seems to be abundantly sanctioned by experience. Not only that, but it is possible to quadruple or quintuple the work accomplished. Besides, mouldy specimens—even when made in rainy seasons or in the moist tropical countries—are wholly unknown to this new press.

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