On the subject of color, it is true that the darker the color is the less we can discern differences in shade in it. That is the reason why in delicate work we always use a half-normal solution, because we see distinctions more clearly in these than in stronger solutions.

Another point is the fact which may be in the mind of some of you, although you have not asked the question: "How do you know the uniformity of these colors?" All the work we have done in our laboratory during the past eight years has been handled as "unknowns." We take these Blake bottles and number them and put the solutions in, and I myself keep the record of them. Then I take a student and ask him to put them in the proper sequence, first the darkest and then the lighter. It is strange how close they can get to it. That opens the question which Dr. Schneider has asked about, the question of how far I can discern distinction on colors, and I am glad that question is asked.

I wish at this time to sound a warning (for it is needed) on the idea of doing quantitative analysis by colorimetric schemes. We recommend colorimetric tests only when the quantity of material to be tested is too small to assay gravimetrically or volumetrically. The sharpest discernable difference in color work is five per cent. We have one solution representing 1 part in 100; another 1 in 110 and another 1 in 90. Dozens of people coming in will put them in the proper sequence. If you have solutions 1 in 90, 1 in 95 and 1 in 100, it takes a fairly good eye to make the distinction, the eye of someone who has studied the subject. If you make then 1 in 92, 1 in 93, 1 in 94 and 1 in 95, nobody can tell. So the limitations of the colorimetric test is say 5 percent which is not, of course, exact scientific work.

The next was the question Dr. Turner asked. I don't know that I have that question exactly.

Dr. Turner: Whether it is necessary to match the color absolutely.

Dr. Arny: I will answer by saying that if we have two colored solutions, one consisting of 50 cc. of the cobalt solution, 4 cc. of the iron and 9 cc. of copper and the second made from 50 cc. of cobalt solution, 5 cc. of iron and 8 cc. of copper, the difference in the tints of these two fluids is easily discernable.

As far as Professor Lloyd's statements are concerned, I want to confirm all he says about the uselessness of lithograph work on color standardization. The first thing we did was to find out from the leading lithographers all we could about the subject and they told us that there is considerable difference between the fiftieth and the hundredth impression from the same plate. Therefore with the same ink they cannot guarantee the uniform coloring of successive impressions.

NOTES ON THE HISTOLOGY OF AN AMERICAN CANNABIS.*

C. W. BALLARD, A. M., PHAR. D.

There is a difference of opinion relative to the therapeutic value of foreign and native Cannabis; in this article their histological characters are compared.

A number of factors are responsible for the revival of interest in American Cannabis sativa. The foreign drug is apparently becoming less plentiful and is consequently increasing in price. Recent legislation has forced some manufacturers to use this drug in place of opium in their remedies. Last but most important is the accumulated data as to the therapeutic value of the native drug as compared with the foreign and although there is yet a lack of complete agreement among authorities, the weight of experimental evidence seems to indicate that preparations of American grown cannabis are almost, if not fully, as active therapeutically as those prepared from the foreign drug.

*Presented at Scientific Section, A. Ph. A., San Francisco meeting.

BOTANICAL CHARACTERS OF THE ENTIRE PLANT.

The sample upon which the following descriptive notes are based was received direct from a collector of crude drug materials. The entire herb with both pistillate and staminate flowers was gathered, so that positive identification and comparison with published botanical descriptions was possible. The foreign hemp being usually shipped in the form of agglutinated tops is not easily compared with descriptions appearing in botanical systems of classification. This sample of native hemp was compared with material furnished by the Bureau of

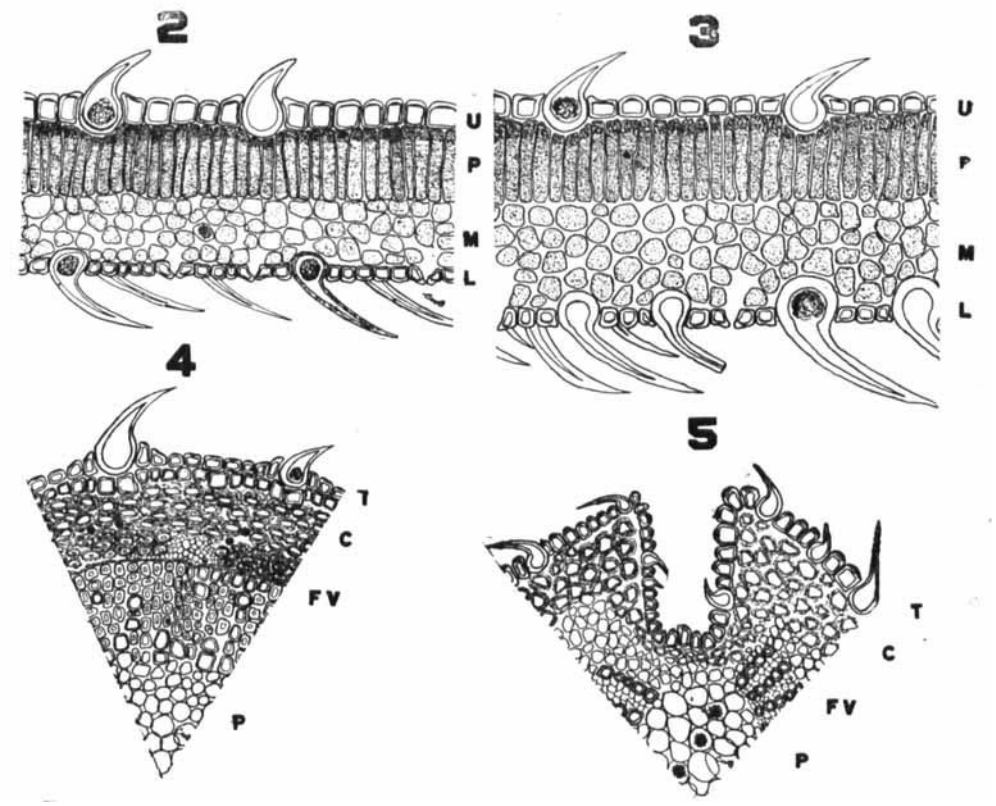

FIG. 2—Transverse Section Leaf of Foreign Cannabis.
U—Upper epidermis with trichomes.
P—Palisade tissue with chlorophyll granules.
M—Mesophyll with rosette crystals.
L—Lower epidermis with stoma and trichomes containing cystoliths.

FIG. 3—Transverse Section Leaf of American Cannabis.
U—Upper epidermis with trichomes.
P—Palisade tissue with chlorophyll granules.
M—Mesophyll with rosette crystals.
L—Lower epidermis with stoma and trichomes containing cystoliths.

FIG. 4—Transverse Section Inflorescense Stem Foreign Cannabis.
T—Epidermis with short trichomes.
C—Collenchymatic layer.
FV—Fibrovascular region.
P—Pith.

FIG. 5—Transverse Section Petiole of American Cannabis.
T—Epidermis with short trichomes.
C—Collenchymatic layer.
FV—Fibrovascular region.
P—Pith.

Plant Industry of the U. S. Department of Agriculture, also with mounted specimens collected in Missouri and Monroe Co., Virginia. The latter specimens were from the Canby Herbarium of the New York College of Pharmacy. All of the above mentioned native specimens correspond with the following description published by Small in "Flora of the South Eastern United States."

"A coarse erect pubescent herb, annual. Leaves alternate or opposite, blades digitately divided into 5 linear or linear-lanceolate, serrate, acuminate segments, 4 to 15 cm. long. Petioles 2 to 8 cm. in length, stipules free and persistent. Staminate flowers in panicled racemes, the panicles being about as long as the subtending leaves. Calyx 4 to 5 mm. broad, consisting of 5 imbricated sepals, oblong or oval, pubescent and obtuse; corolla wanting. Stamens about as long as the sepals, 5 in number. Pistillate flowers in spikes found in the axils of the leafy bracts, having an entire perianth of calyx only, subtending a sessile one-celled ovary. Achenes oval-lenticular 4 to 5 mm. long, variegated, enclosed in the persistent perianth. Embryo curved."

COMPARISON OF THE TOPS OF FOREIGN AND NATIVE CANNABIS.

The tops of foreign cannabis are minutely described by the Pharmacopœia and the essential points of this description are here given.

"Dark green or brownish in color, densely branched panicles, the branches of which are compressed and agglutinated by resin into terete or flat masses; clothed with numerous sheathing bracts each containing two small mature but unfertilized pistillate flowers. In the powder few or no pollen grains or stone cells should be present."

The tops of Cannabis sativa native, as represented by my sample, present considerable variation in appearance from those of foreign drug and these differences are not only due to methods employed in preparing the latter drug for market but also to the habit of the native drug plant. We must bear in mind that the native drug is obtained from an uncultivated herb; the plant yielding the foreign has undoubtedly been somewhat modified by years of careful cultivation, also the tops of the latter are kneaded or worked into masses, while the native drug does not undergo such preparation. The tops and flowers of the native drug are colored a light green instead of the usual brown tint of the foreign.

HISTOLOGICAL CHARACTERS OF FOREIGN AND NATIVE CANNABIS.

For purposes of contrast we may briefly review the histological characters of foreign cannabis, the only variety admissible under present standards. The cellular elements and contents present are:

1. Many curved unicellular trichomes often containing cystoliths of calcium carbonate in the enlarged basal portion of the cavity, margin of the trichome smooth or nearly so, trichomes of two varieties, one of which is short but very broad, derived from the stem and upper leaf epidermis; the other being longer and narrower found on the lower leaf epidermis.
2. Glandular trichomes having a short many-celled petiole.
3. Epidermal tissue of polygonal or wavy cells, the lower epidermis having stoma.
4. Parenchyma or mesophyll containing resin masses, chlorophyll granules and numerous rosette crystals.
5. Small amounts of fibrovascular tissue consisting of thin walled fibers and spiral vessels.

The Cannabis americana of the Fifth Revision of the Pharmacopœia con-

sists of flowering tops, and no designation of pistillate or staminate flowers appears. Even in that edition of the Pharmacopœia the pistillate tops only of foreign hemp are designated as official. As the sample described was in the form of the entire herb, we may for convenience divide the cellular elements into those derived from the leafy stems and those from the tops.

Stem Elements.—The smaller stems of native cannabis are five to six angled with distinct furrows on the flat sides. The larger stems and those immediately adjacent to the root are circular in outline. In general they are not as stout as the stems of the foreign drug. The upper portions of both have a distinctly hispid surface and it is disagreeable to draw the finger over them, but the native is by far the rougher. The petioles of the leaves have a deep furrow on the upper surface. As stems make up a large portion of the sample submitted, we naturally find large amounts of fibrovascular tissue in the form of long thin-walled fibers with spiral and reticulate vessels. On transverse section the stems of the native drug are found to consist of epidermis armed with numerous short, very rough and stout trichomes; below this is a well defined collenchymatic layer which completely surrounds the fibrovascular elements. In the center is a small pith region the cells of which contain numerous crystals of the rosette type. Transverse sections of the stems of foreign drug exhibit the same elements as the native but there is less collenchyma, fewer and smoother trichomes on the epidermis and a larger pith. The foreign drug has a much greater amount of resin in the form of irregular masses occurring in the parenchyma cells.

The tissue elements of the leaves were very prominent in the powder prepared from the sample under consideration. Such an increase in the amount of leaf tissue might explain the increased number of protective trichomes present in the sample. Transverse sections of the leaf of the native drug show that it has the greater number of protective trichomes on the lower surface, is a thicker leaf and contains less resin than the foreign. The number of glandular trichomes is about equal in the two powders. The chlorophyll granules of the native drug are large and bright green.

Tops of Native Cannabis.—The histological differences in powders prepared solely from the tops of foreign cannabis and from those of the sample submitted were fully as striking as the differences in appearance of the drugs in the whole condition. The most apparent feature of the powdered American tops is the abundance of pollen. In a powder of foreign cannabis any abundance of pollen would indicate careless cultivation or gathering and would cause the rejection of the sample on the ground that official drug is defined as consisting of pistillate tops only. Unicellular trichomes of both short and long varieties are found in greater number in the native sample. This difference might be expected when one considers that the native drug is not gathered from cultivated plants as we have other instances where care and cultivation seem to lessen the necessity for protection afforded by trichomes. There are several minor differences in the trichomes of stem and leaf in the two drugs. The trichomes of the tops and more especially the stems of native drug are apt to be more papillate or rough surfaced. In some cases this roughening is so marked as to give the hair a surface appearance similar to that of senna. The cavities of the trichomes of native hemp are smaller than those of the foreign and the cystoliths in the basal portion

are not as numerous. Some of the trichomes of the native drug are but rudimentary appearing as mere papillae.

SUMMARY

American Sample	*Foreign Sample*
Pollen Large quantity	very scarce
Trichomes	
number—great	great
surface—very rough	less roughened
size—large and small in equal quantity	more large than small
cavity—small at base	large at base
papillae—on leaf surfaces and stem epidermis	few
Leaf tissue great amount	moderate quantities
Mesophyll bright green	brownish green
Fibrovascular tissue large in amount	small in amount

We must realize that the fragmentary notes here presented are open to review and enlargement. A complete treatment of the subject of Cannabis sativa would require investigation of the slight differences in botanical and histological structure not only of a few samples of the two drugs but of many specimens from as wide a range of territory as possible. If the materials for such a study were available we would undoubtedly find many minor differences resulting from climatic conditions.

COLUMBIA UNIVERSITY, COLLEGE OF PHARMACY.

THE CULTIVATION OF MEDICINAL PLANTS WITH OBSERVATION CONCERNING CANNABIS.*

L. E. SAYRE.

The Author dwells upon the importance of cultivation of medicinal plants in the United States. He has recently traveled in the South and refers to the advantages of Georgia's climate and soil for medicinal plant cultivation and the advantageous location of experiment stations of that State. The Author refers to some experimental work at Glenolden and states that despite contrary statements, Cannabis is an important and reliable drug.

One of the first experiments in the cultivation of medicinal plants in the United States on which the author was in position to make some personal observations was about the year 1887 when a friend of his (Mr. C. B. Allaire) had received through Dr. E. R. Squibb some genuine Trieste seed of the official fruit, colocynth. Mr. Allaire kindly asked the writer's co-operation in the experimental research—he to cultivate the plant (near Albuquerque), and the writer to make an analysis of the fruit product when it had matured. To the writer's surprise a barrel of this fruit was received which was nearly as large as a small water melon. This enormous size, it was found, was due to hybridization. Mr. Allaire had not taken the proper precaution to isolate the colocynth patch. It had been

*Read before Scientific Section, A. Ph. A., San Francisco meeting.