pendent sets of measurements—namely, viscosity.

Recently Fessler and Ogston (*6*) have shown that the $1/S$ vs C curve for sodium thymonucleate solution in presence of about 2% sodium chloride is linear, with positive slope over a considerable range of concentrations. This evidently follows from the statement made in the previous note (*1*) as to the complete suppression of dissociation of sodium thymonucleate molecules in the presence of excess of sodium chloride, with the consequent assumption of an average coiled-up structure by the thymonucleate molecules in solution.

References

1. Basu, S. *Nature*, **168**, 341 (1951).
2. Tennent, H. G., and Vilbrandt, C. F. *J. Am. Chem. Soc.*, **65**, 427 (1943).
3. Burgers. *Proc. Koninkl. Nederland. Akad. Wetenschap.*, **44**, 1045 (1941).
4. Newman, B., and Eirich, F. R. *J. Colloid Sci.*, **5**, 542 (1950).
5. Kirkwood, J. G., and Riseman, J. E. F. *J. Chem. Phys.*, **16**, 565 (1948).
6. Fessler, J. H., and Ogston, A. G. *Trans. Faraday Soc.*, **47**, 667 (1951).

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Variation in Coloring Rates of Tobacco[1]

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One of the more dramatic changes that take place during the flue-curing of tobacco is the transformation of the field-green leaf to the bright-orange or yellow tobacco of commerce. This color change comes about through the enzymatic destruction of chlorophyll and results in the unmasking of the yellow carotenoids that are already present. Under the conditions prevailing in the curing barn, coloring, as this phase of the process is called, is accomplished during the first 36–60 hr of the curing sequence, depending on weather conditions and the stalk positions harvested.

The progress of the development of the yellow color serves as the basis for advancing the temperature and ventilation schedule. The operator periodically examines the tobacco as it hangs in the curing barn. There in the half-light he estimates the average stage of the destruction of chlorophyll and adjusts the environment accordingly.

Because of the importance necessarily attached to this color transition as an indicator of curing progress, it seemed expedient to examine the changes in the reflectance spectra of tobacco leaves undergoing yellowing, with the ultimate aim of devising an instrument to replace the human eye for this critical evaluation. The reflectance spectra of tobacco during progressive yellowing are shown in Fig. 1. Fig. 2

[1] Contribution of the North Carolina Agricultural Experiment Station and published as Paper No. 384 of the Journal Series.

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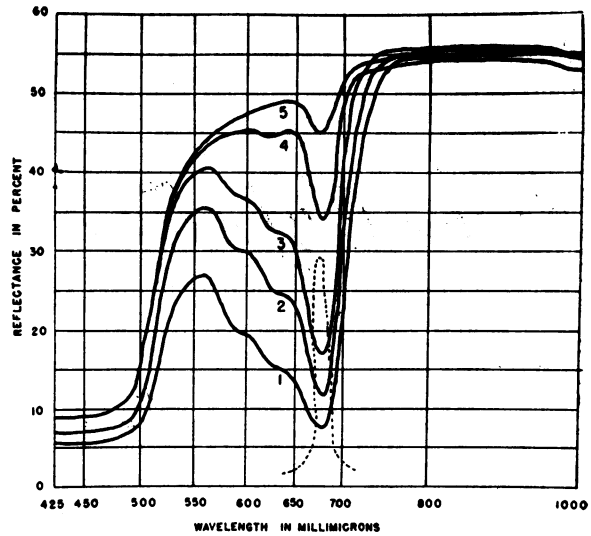

Fig. 1. Changes in the reflectance spectra of tobacco during the early stages of curing; Curve 1, mature leaf at priming; Curves 2, 3, 4, progressively yellower leaves; Curve 5, fully yellowed leaf. (Tracings made with a GE Recording Reflectometer, courtesy Sidney Blumenthal Company, Rocky Mount, N. C.) The broken curve gives the transmittancy characteristics of the filter used in the Yellowmeter.

shows the resulting portable reflectometer[3] being used to measure yellowness. This "Yellowmeter" registers increasing yellowness positively, whereas it actually measures the decreasing absorption of chlorophyll at 680 mμ wavelength. Light from 2 flashlight bulbs on either side of the instrument is reflected by the leaf in position under the lid and is received by a phototube. An electrometer circuit amplifies the phototube current so that it can be measured with a microammeter. An interference filter over the photocell transmits only the wavelengths in the red region

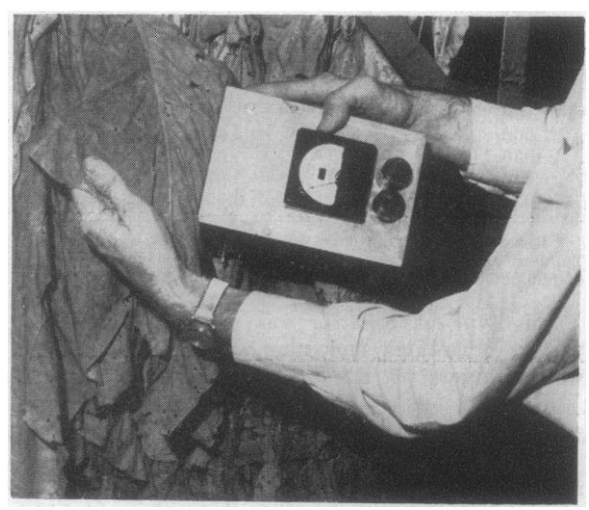

Fig. 2. Measuring reflectance of tobacco in the curing barn with the Yellowmeter.

[3] Instrument developed cooperatively by North Carolina Agricultural Experiment Station and Division of Farm Electrification, U. S. Department of Agriculture.

of chlorophyll absorption (Fig. 1). In use the instrument is calibrated by adjusting the light intensity to give full-scale deflection for an arbitrary white standard. (For convenience, the standard used here was an ordinary glazed white file card taped to the underside of the lid.) Subsequently, when measuring tobacco, the reflectance of the leaf, relative to the standard, registers directly.

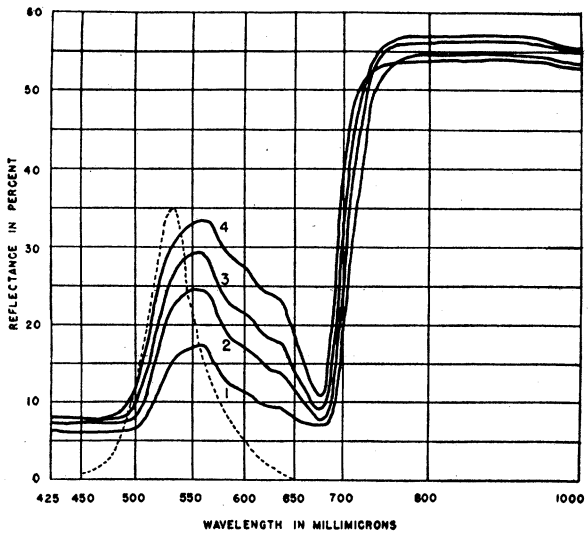

FIG. 3. Changes in the reflectance spectra of tobacco during ripening: Curve 1 is an immature leaf; Curves 2 and 3 are progressively riper; Curve 4 is for an overripe leaf. (Tracings made with a GE Recording Reflectometer, courtesy Sidney Blumenthal Company, Rocky Mount, N. C.) The broken curve gives the energy distribution from the light source used in the photoelectric sorter.

In a curing experiment at the Tobacco Experiment Station, Oxford, N. C., during the 1949 season, 25-leaf samples, randomly made up from leaves preselected for uniformity, were removed for analysis at 12-hr intervals during curing. Reflectance measurements of the face surface were made with the Yellowmeter on each leaf of the samples removed after 12 hr curing had elapsed. The coefficient of variation between leaves in the same sample was surprisingly large, amounting to 28% of the mean reflectance of the sample. After 24 hr curing, the between-leaf variation was again 28%. As the yellowed condition was approached after 36 hr curing, the variation in the samples was reduced to 20%. Three possible explanations for this wide variation were proposed: (1) selection of the leaves for uniformity at priming was not as good as supposed; (2) the destruction of chlorophyll started earlier in some leaves than in others; or (3) the reaction proceeded at more rapid rates in certain leaves. As some of the leaves became yellow, the slower ones had a chance to catch up; hence, the decreasing variation as yellowing approached.

To test this variation in coloring rates more critically, 100 tobacco leaves were very carefully selected for uniformity in the field. In addition to this visual

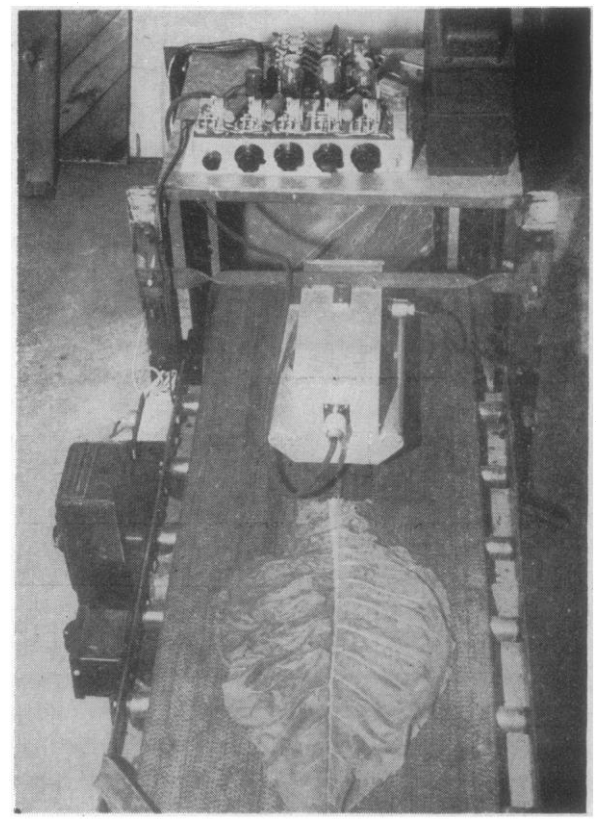

FIG 4. Conveyor belt equipment for sorting tobacco on the basis of ripeness.

selection, these leaves were further screened by an experimental photoelectric selector (Figs. 3 and 4), which sorts tobacco leaves according to their reflectance of green light. (Fig. 3 shows how green reflectance of tobacco changes during ripening, as well as the energy distribution from the light source in the photoelectric sorter.) The important fact is that this instrument rejected 20% of these leaves as being overripe. Subsequent measurement of the rejects with the Yellowmeter showed that they were significantly yellower than the remaining leaves.

The selected leaves were then randomly made into 20-leaf subsamples. After measuring the reflectance of each individual leaf on the Yellowmeter, the samples were placed in curing. At intervals during the coloring period, reflectance measurements were again made on the opposite half of each leaf in a particular sample. Yellowmeter readings were repeated on all leaves toward the end of yellowing and again at the completion of the cure. Mean reflectances and their fiducial limits are plotted against curing time in Fig. 5. In Fig. 6, the between-leaf coefficients of variation are plotted against time.

Tobacco leaves that had been selected visually and instrumentally for uniformity (only 6% coefficient of variation) responded quite differently to the coloring environment of the curing barn. The variation increased to a maximum of 28% about 15 hr ahead of

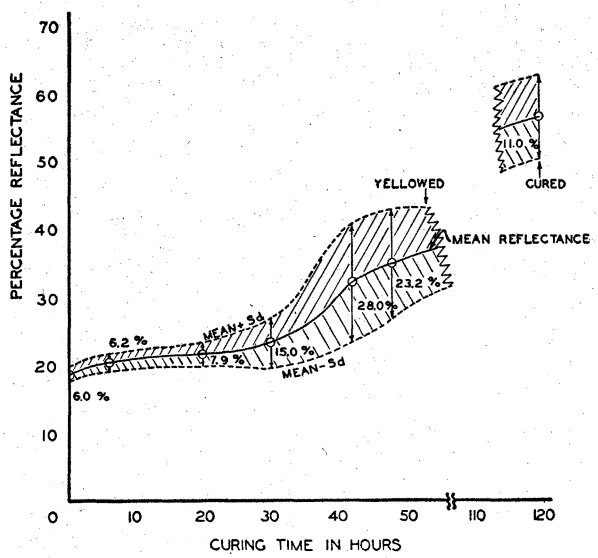

FIG. 5. Changes in the 680 mμ reflectance of tobacco during curing.

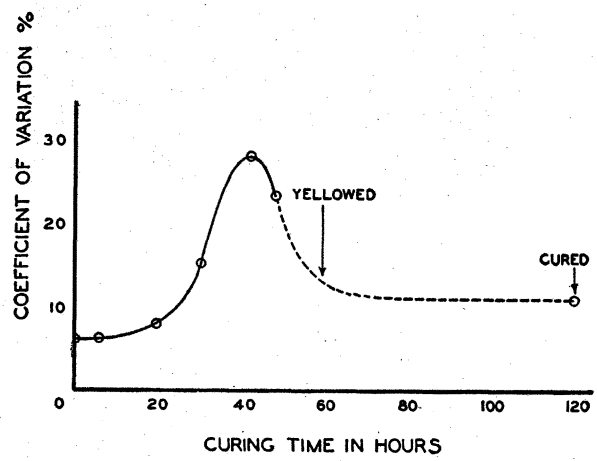

FIG. 6. Variation in the 680 mμ reflectance of tobacco during curing.

yellowing (a sample judged visually to be satisfactorily yellowed would be expected to show a mean 680 mμ reflectance of about 40% on the Yellowmeter) and then declined. After curing was completed, the coefficient of variation was 11%.

Enzymatic activity of the laminal portions of the leaves is arrested through desiccation during the fixing stage of curing; therefore, little further color change would be expected during the final drying phase. For this reason, the curve in Fig. 6 is interpolated essentially horizontally during the drying cycle.

These variable rates of coloring of tobacco are undoubtedly the combined effects of inherent physiological differences between leaves and the curing environment of each particular leaf. That environment is the more important factor might be inferred from the observation that when 2 leaves were hanging close together, such as face-to-face, both leaves would show retarded yellowing. Since both the highly selected leaves and those less carefully selected followed the same pattern in their coloring behavior, this might explain the rather remarkable success of the careful operator in curing out uniformly colored tobacco from leaves that may have been rather carelessly primed for uniform maturity. It should be emphasized, however, that color per se is of only minor direct importance in determining the quality of cured tobacco.

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Fasciae Dorsi Variants

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Incident to routine and certain special dissections it developed that gross anatomical findings upon some fascial entities of the back were different from those recorded in standard textbooks. We wish to place on record such new or apparently unreported observations.

Records that have formulated much of the older, as well as later, concepts upon the gross structure of fasciae are based largely upon studies of adults and the aged. Because of the predilection of collagenous tissues for fusions or adhesions, our work was undertaken on newly born, full-term infants, as well as on adult cadavers. Fascial studies were made upon 6 infants and 6 adults (24 sides), but structural patterns observed by us in 9 student-dissected bodies were totaled with our own dissections (total, 21 cadavers [42 sides]). Routine and special techniques of dissection were employed, such as lateral and medial approach to the field, en bloc resections, variable approaches, etc.

Variations from standard texts were noted in our studies of lumbodorsal fascia. The most striking difference is our finding that the dorsal layer of this fascia (lumbar aponeurosis) sometimes projects rostrad by splitting into anterior and posterior laminae, which ascend as vaginal fasciae covering, respectively, these surfaces of the splenius cervicis and capitis muscles. This pattern was observed in 88.1% of our subjects. A third but diminutive vaginal fascia was projected rostrad as the dorsal covering of the spinalis, semispinalis, and longissimus muscles under the splenii. This layer thickens, however, over the semispinalis capitis in the occipital triangle. (See Fig. 1, paraspinous sagittal section, through bases of transverse processes in the thoracolumbar area and the articular and transverse processes of the cervical vertebrae.)

Fascial planes of the trigonum lumbale (Petiti) were found in homologous structural patterns with those of the occipital triangle, except for numbers of muscles engaged and several other minor variants,

[1] Acknowledgment is made to Charles Mayo Goss, head of the Department of Anatomy, Louisiana State University School of Medicine, for criticisms and suggestions.