

ately oriented by suitable optical methods. In addition, the epitaxy will confirm or deny the single crystal character of the boule. If the boule consists of more than one crystal, the grain boundary is easily delineated by the discontinuity in reflections from the cube face. Thus, in the case of recrystallized sheet AgCl wherein the grains are 1 cm or more in size the epitaxy of NaCl on the sheet consists of polygonal areas of commonly oriented cubes so that an orientation can be assigned to each grain. In the case of a cylindrical or hemispherical surface of a single crystal the epitaxy is observed to be complete—that is, valid for all orientations of the silver halide surface.

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Spectrophotofluorometric Assay in the Visible and Ultraviolet

With the commercial instruments now available, fluorescence assay has been applied to many compounds that are visibly fluorescent. This paper (1) describes an experimental instrument that extends the scope of fluorescence analysis to permit the excitation of compounds and the measurement of the resulting fluorescence throughout the ultraviolet and visible regions. The instrument, which we call a *spectrophotofluorometer*, has been applied to a number of problems involving both identification and quantitative assay of organic compounds. Data obtained with indoles and 5-hydroxyindoles illustrate the usefulness of the instrument.

The apparatus (Fig. 1) consists of a 125-watt xenon arc to provide uniform

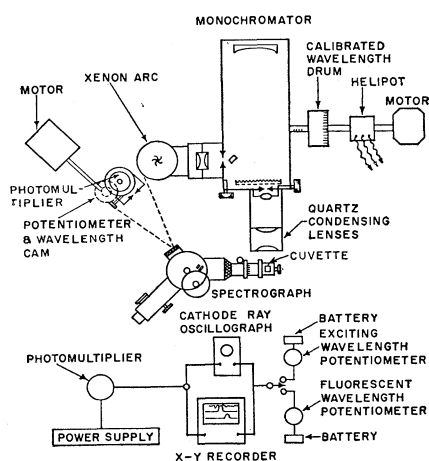


Fig 1. Schematic arrangement of spectrophotofluorometer and block diagram of electric components.

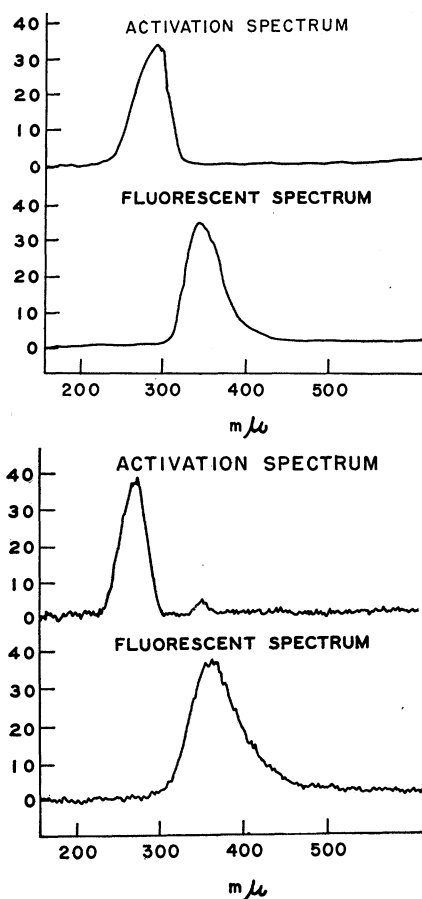


Fig. 2. Activation and fluorescence spectra of tryptophan (top) and 5-hydroxytryptamine (bottom). The units on the ordinates are arbitrary.

light output from the ultraviolet through the visible, together with a Bausch and Lomb grating monochromator to select the activation wavelength. The sample, about 1 ml, is placed in a 1-cm² silica cuvette. The fluorescent light is analyzed by passing it through a modified quartz prism microspectrograph equipped with a mechanical scanning device containing an ultraviolet-sensitive photomultiplier type 1P28. The photomultiplier output is coupled to the vertical axis of a cathode-ray oscilloscope, and the output of a potentiometer coupled to the wavelength cam is applied to the horizontal axis.

In operation, the phototube scanning the emitted fluorescent light plots a wavelength versus intensity diagram on a Du Mont type 304H cathode-ray oscilloscope. This is designated as the fluorescence spectrum. The same signal may also be supplied to a pen-and-ink recorder or to a galvanometer. A wavelength information signal is also provided on the input monochromator so that when the fluorescence analyzer is set to the wavelength of the peak output, the incident wavelength can be varied through the visible and ultraviolet. Fluorescence intensity plotted against

the wavelength of the activating light yields a curve designated as the activation spectrum. The wavelength of the exciting light is determined from the calibrated monochromator dial standardized against the lines of a mercury arc. The location of the maximums in the curves presented in Fig. 2 are accurate to ± 5 mμ, but their shapes are slightly deformed as a result of several minor optical defects.

Activation and fluorescence spectra of tryptophan and 5-hydroxytryptamine (serotonin) are presented in Fig. 2 (2). These spectra are typical of those of other indoles and 5-hydroxyindoles. Over the range of pH from 2 to 11, 5-hydroxyindoles are maximally activated at 295 mμ and fluoresce at 330 mμ, whereas indoles are activated at 275 mμ and fluoresce at 360 mμ. All the indole and

Table 1. Activation and fluorescence maximums of some organic compounds.

Compound	Medium	Activation (mμ)	Fluorescence (mμ)
Tryptamine	pH 2-11	275	360
Tryptophan	pH 2-11	275	360
Indoleacetic acid	pH 2-11	275	360
Indole	pH 2-11	275	360
5-Hydroxytryptamine	pH 2-11	295	330
5-Hydroxytryptophan	pH 2-11	295	330
5-Hydroxyindoleacetic acid	pH 2-11	295	330
Epinephrine	0.01N H ₂ SO ₄	275	320
Norepinephrine	0.01N H ₂ SO ₄	275	320
Dihydroxyphenylalanine	0.01N H ₂ SO ₄	275	320
Tyrosine	0.01N H ₂ SO ₄	270	300-330
Morphine	0.01N H ₂ SO ₄	270-290	365
o-Aminophenol	4N H ₂ SO ₄	265	310
m-Aminophenol	4N H ₂ SO ₄	265	310
p-Aminophenol	pH 8	295	365-370
o-Hydroxybenzoic acid	pH 5-6	290	420
m-Hydroxybenzoic acid	0.1N NaOH	315	420
p-Hydroxybenzoic acid	0.1N NaOH	280	330
Aniline	pH 9	290	360
Lysergic acid diethylamide	pH 9	315	440

5-hydroxyindole compounds examined (Table 1) fluoresce with sufficient intensity that 0.1 to 0.4 µg/ml can be measured. This sensitivity has made it possible to develop a fluorimetric procedure, described elsewhere (3), for the determination of 5-hydroxytryptamine in blood. This compound is found in human blood to the extent of about 0.1 to 0.2 µg/ml.

Fluorescence evoked by ultraviolet radiation below 365 mµ is not peculiar to the indole compounds but occurs with a large number of organic compounds. The results of a preliminary survey of organic compounds that show both visible and ultraviolet fluorescence are presented in Table 1.

The instrument described is intended only to provide information about the utility and design of a spectrophotofluorometer. A more practical form of this instrument is currently being designed.

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References and Notes

1. We wish to express our appreciation to Bernard B. Brodie, who was instrumental in getting this study under way.
2. 5-Hydroxytryptamine was made available by Abbott Laboratories and Upjohn Laboratories as the creatinine sulfate complex. 5-Hydroxytryptophan and 5-hydroxyindoleacetic acid were synthesized by A. Ek and B. Witkop. The other indole compounds were commercial samples that were shown to be chromatographically pure.
3. S. Udenfriend, C. T. Clark, H. Weissbach, *J. Biol. Chem.*, in press.

4 April 1955

Priority for Reporting of Scientific Discoveries

Many problems concerning priority for the reporting of scientific discoveries are symptomatic of the fierce competition that often underlies the professional relationships among scientists. Although it can be demonstrated, historically speaking, that many scientific discoveries have been announced by several investigators almost simultaneously or within an exceedingly short period of time (1), various individual names are associated with these discoveries, even though the work of others may have been of equal magnitude. On the other hand, many scientists do not even bother to give credit to those who hold priority for scientific ideas; and thus they strive to establish an impression that priority for these ideas belongs to themselves (2). Much of this behavior, of course, is concerned with the general emotional problems of scientists in a world where competition for prestige

is perhaps even more important than competition for monetary gain (3).

From the practical standpoint, nevertheless, the remarks of Lillie (4) on the subject of spurious publication dates are of considerable importance. This is especially true in the field of systematics, where priority establishes the name of a new species, genus, and so forth, and thus avoids the chaos that would otherwise result.

With regard to the general question of priority that was discussed by Lillie, we agree that the actual publication date should be clearly defined with regard to priority. As an example, according to the *International Rules of Zoological Nomenclature* the date of publication is the date on which the publication was mailed or placed on sale (5). It appears to us that the actual date of mailing (or sale) of the journal issue is a logical basis for appraising priority because it represents the shortest period in time between unavailability of scientific papers and the moment when they begin to exert "influence on the progress of research in other institutions" (4).

Lillie also suggests that journals print the date of receipt of a paper, but he does not seem to clarify the reasons for this proposal. Many journals do indicate the dates of receipt, but, as Lillie suggests, these dates generally are ignored. It appears to us that the date of acceptance of a paper has more value than the date of receipt. In some cases these two dates occur close together, but in many others a considerable period intervenes between receipt and acceptance, which may be preceded by several revisions. The date of acceptance might well be considered as the major basis for appraising priority because it constitutes the final act in the chain of scientific "cerebration, instrumentation, manipulation, and interpretation" (6).

The problem of assigning priority to a paper published in a journal dated in the year just preceding the year of actual mailing would probably be solved if all journals showed both the actual mailing dates on the particular issues and the dates of acceptance on the particular papers. The date of acceptance would also prevent the assignment of priority to paid papers, which are usually published in the next issue of the journal. A prominent American journal states in its notice to contributors that "accepted papers which raise no questions of scientific priority may however secure earlier publication . . ." if the cost of publication is paid. The danger of this policy lies in the fact that the editorial board cannot know whether a question of priority exists except with regard to its own journal. Thus the date of acceptance becomes vital, for a paid paper may announce a discovery a year or more prior to publi-

cation of a similar finding that was in press when the paid paper was accepted. This might discourage rapid publication of paid papers written by unscrupulous or emotionally insecure scientists who have gleaned material either from manuscripts in preparation by colleagues or from those, written by colleagues, that are already in press.

In summary, we propose that journals show both the actual date of mailing of the journal and the date of acceptance of the paper as the basis for priority. Furthermore, these dates should also appear on reprints or tear sheets for distribution by authors. Finally, editors might well require authors to include the mailing date of a journal in bibliographic citations.

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References

1. B. J. Stern, *Social Factors in Medical Progress*, (Columbia Univ. Press, New York, 1927), chapt. 3; W. F. Ogburn and D. Thomas, *Political Sci. Quart.* 37, 83 (1922).
2. M. C. Hall, *Sci. Monthly* 47, 152 (1938).
3. L. S. Kubie, *Am. Scientist* 41, 596 (1953); 42, 104 (1954).
4. R. D. Lillie, *Science* 120, 7A (15 Oct. 1954).
5. E. Mayr, E. G. Linsley, R. L. Usinger, *Methods and Principles of Systematic Zoology*, (McGraw-Hill, New York, 1953), chapt. 11.
6. W. A. Wildhack, *Science* 120, 15A (22 Oct. 1954).

14 January 1955

Physical and Chemical Factors in Relation to *Histoplasma capsulatum* in Soil

The geographic variation in the prevalence of histoplasmin sensitivity is an established epidemiologic fact, but the basis for this phenomenon remains unknown. Undoubtedly the variation results in part from factors that influence the occurrence and distribution of the sensitizing agent, *Histoplasma capsulatum*, in the environment.

The primary source of *H. capsulatum* is believed by most investigators to be soil, but the fungus is not found in all soils. Even within an area of high prevalence of histoplasmin sensitivity such as Williamson County, Tenn., *H. capsulatum* has been isolated with significantly greater frequency from some soils than it has from others (1, 2). Studies have demonstrated that the fungus is cultured predominantly from soils in places frequented by chickens, although chickens are not a reservoir of histoplasmosis. It is logical to assume that qualitative or quantitative variations in the chemical components or physical characteristics of different soil specimens may be at