Communications

Were the Carolina Bays Oriented by Gyroscopic Action?

C. Wythe Cooke (*1*) has presented an explanation for the ellipticity and orientation of the Carolina Bays that is based on an assumed gyroscopic property of a rotating body of water.

I made an investigation of the effects of the spin of the earth on the particles of water in a spinning eddy at 30°N latitude, the circular eddy being 2 mi in diameter and 100 ft deep and having a water velocity of 4 mi/hr near the shore.

The "deflection-to-the-right" effect, together with the centrifugal reaction out from the center of the eddy, causes the level of the water everywhere near the shore to be approximately 6 in. higher than it is at the center of the eddy. These effects are independent of the depth of the water.

The change in the centrifugal reaction out from the center of the earth, caused by the horizontal velocity of the water relative to the earth, causes the water (in the lockwise eddy) to be less than 1/16 in. higher near the north shore than near the south shore. This difference in level increases with the depth of the water in the eddy.

It appears that all these effects could neither cause ellipticity nor influence the orientation of an eddy, for example, a Carolina Bay. Contrary to Cooke's assumption, an eddy does *not* exhibit gyroscopic action. In an earlier publication (*2*) I pointed out that gyroscopic action is exhibited only by rigid bodies and that an eddy is not a rigid body. However, no solution for the problem was presented. The complete report of this study will be submitted for publication elsewhere.

It seems that my conclusion stated in 1951 still is correct, namely, "A meteorite theory of origin of the Carolina Bays appears to be the least unsatisfactory of all the theories that have been published."

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Spectral Emission of Composite Liquid Phosphors

It is well known that mixtures of solute phosphors are, in many cases, more efficient light emitters (in the visible) than either of the constituents alone. Owing to the energy transfer from the primary to the secondary phosphor (present in lesser concentration), the spectrum is shifted toward longer wavelengths. As a consequence, the self-absorption (concentration quenching) is greatly reduced, and hence a higher light output is obtained (*1*). Besides, a better match with the S-4 and S-9 cathode sensitivity of the photomultipliers commonly used yields increased quantum-efficiency of the light collected.

The process of successive energy transfers among the various constituents of the solution, even though clear in its main features, is still discussed in its details among different investigators (*2*). Since, according to several authors, the spectral distribution of the luminescence produced is independent of any particular way of excitation (*3, 4*), fluorescence (under ultraviolet irradiation) and scintillation (under gamma-ray or particle bombardment) should both be identical phenomena, insofar as ultimate light production is concerned. Thus, better insight into the energy-transfer mechanism might be gained by directly exciting—through selected narrow bands of ultraviolet light—different constituents of the mixture in succession (*5*). This affords a possibility to examine the processes involved (degradation, quenching, energy

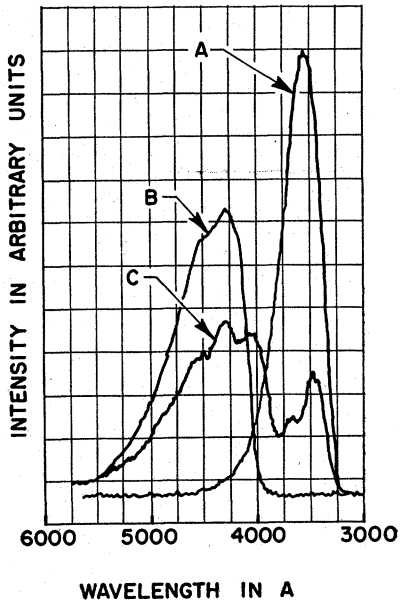

Fig. 1. Emission spectra (under gamma-ray bombardment of Co^{60}) of (*A*) *m*-xylene with 3 g/lit *p*-terphenyl; (*B*) *m*-xylene with 3 g/lit *p*-terphenyl and 10 mg/lit diphenylhexatriene; (*C*) *m*-xylene with 3 g/lit *p*-terphenyl and trace of diphenylhexatriene. A lucite cell (1 in. long) containing the solutions was placed in front of the slit of a Bausch & Lomb quartz monochromator and the spectral distribution was measured with an RCA-C7151 photomultiplier. The spectra (normalized to equal total intensity) show a complete shift in the spectral distribution from the primary to the secondary phosphor at the (optimal) concentration corresponding to case (*B*).

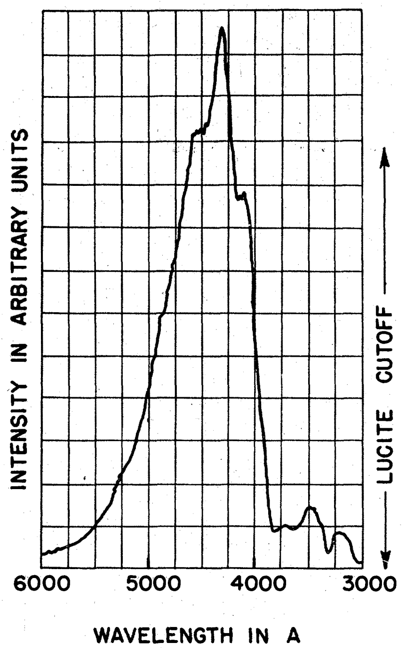

Fig. 2. Emission spectrum (under irradiation with ultraviolet light) of *m*-xylene with 3 g/lit *p*-terphenyl and 10 mg/lit diphenylhexatriene. A lucite cell containing the solution was placed in front of the slit of a Bausch & Lomb quartz monochromator and illuminated by a Hanovia hydrogen discharge tube in such a way that little direct light from the source could be recorded (absence of typical H-lines, as seen in Fig. 3). The shift is seen to be similar to the one obtained under gamma-ray bombardment, with a negligible amount of the *p*-terphenyl peak remaining.

transfer, and so forth) at each stage separately, greatly reducing therefore the complication of all these factors taken at once.

However, it has been pointed out recently that the fundamental identity of all the luminescent phenomena generally assumed might fail to be upheld by experiment. Although under radioactive excitation a complete shift of the original spectrum is observed on addition of a second solute phosphor (in a crystalline, plastic or liquid mixture) (*6*), for ultraviolet irradiation no such total shift could be detected in a recent experiment (*7*). Toluene containing $10^{-4}M$ of alphanaphtylphenyloxazole (ANPO) and *p*-terphenyl in concentrations ranging from $10^{-2}M$ to $10^{-5}M$ was used. The characteristic peak of the ANPO waveshifter shows up at $\lambda = 4150$ A, while the whole spectral distribution of *p*-terphenyl persists with somewhat diminished intensity (depending on the relative concentration of both phosphors).

Other investigations, on the contrary, rather seem to indicate a fundamental identity of the light-producing mechanism in both cases (*4*), even though the scintillation process in its entirety is vastly more complicated—and somewhat lengthened (*8*)—by many direct and indirect effects connected with the nature of radioactive bombardment (higher excited states, chemical dissociation, electric fields, mutual perturbation by neighboring excited and ionized molecules, and so forth) (*9*).

Measurements that I made (*10*) on double solute phosphors also show a complete spectral shift, thus supporting the view that both luminescent processes (scintillation and fluorescence) are identical phenomena. Both emission and absorption spectra were investigated. A Bausch & Lomb quartz monochromator was used. The spectral distribution was taken with an ultraviolet-sensitive photomultiplier (RCA-C7151) and traced out on a Brown Electronik recorder. For the emission spectra a lucite cell (1 in. long) containing the solutions (*m*-xylene with 3 g/lit *p*-terphenyl and 10 mg/lit diphenylhexatriene) was placed in front of the slit of the monochromator. For the absorption measurements, a lucite cell (2 in. long) was placed between the monochromator and the photomultiplier. A 20-mc Co^{60} gamma-ray source and a Hanovia hydrogen discharge tube were used to produce the excitation of the phosphors.

It is seen from the results, shown in Figs. 1, 2, and 3, that the characteristic features of the spectra under light and gamma-ray excitation appear to be nearly identical.

It has to be pointed out, however, that no exact quantitative comparison for transfer efficiency and light yield of different solutions under radioactive bombardment and ultraviolet excitation can be drawn

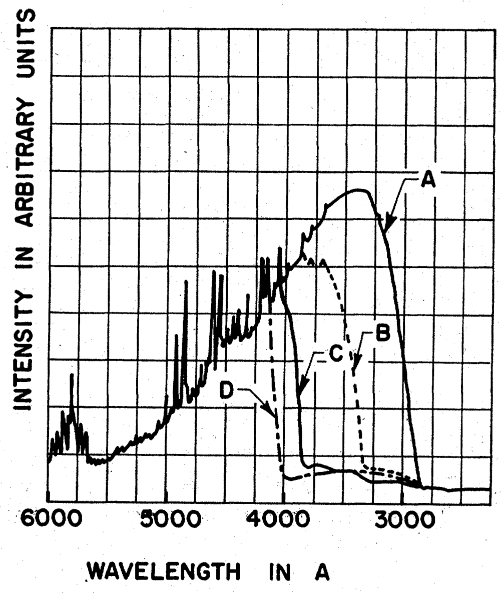

Fig. 3. Transmission spectra of ultraviolet light (Hanovia hydrogen discharge tube) through a lucite cell (2 in. long) placed between a Bausch & Lomb quartz monochromator and a recording RCA-C7151 photomultiplier: (*A*) lucite cell empty; (*B*) lucite cell filled with *m*-xylene and 3 g/lit *p*-terphenyl; (*C*) lucite cell filled with *m*-xylene and 3 g/lit *p*-terphenyl with a trace of diphenylhexatriene; (*D*) lucite cell filled with *m*-xylene, 3 g/lit *p*-terphenyl and 10 mg/lit diphenylhexatriene. The spectra have been normalized to equal differential intensity.

from the curves, since (i) no correction has been applied for the varying sensitivity of the photomultiplier at different wavelengths; (ii) the curves have been recorded under different monochromator slit widths and photomultiplier voltages.

However, they show, quite adequately, that for the optimal concentration of solutes, as commonly used, a rather complete shift to the spectrum of the secondary phosphor seems to occur, independently of the particular way the luminescence in the liquid is excited.

I am not prepared, at present, to determine the possible origin of the discrepancies observed in spectral shifts produced by second solutes in liquid scintillators.

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References and Notes

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10. This investigation was assisted by the joint program of the U.S. Office of Naval Research and the U.S. Atomic Energy Commission. I am indebted to the National Research Council of Brazil (Conselho Nacional de Pesquisas) for granting a fellowship. Sincere thanks are due to R. Hofstadter for his continuous interest in the work and to W. Van Sciver for valuable assistance in taking the spectrograms.

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Value of a "Negative" Experiment in Extrasensory Perception

When is a negative result of sufficient value to warrant publication in *Science*? This question is raised by the report of Smith and Canon (*1*) on what they considered to be an experiment in extrasensory perception (ESP). After giving an ESP test to psychology students, they obtained results attributable to chance, results which therefore provided no evidence of ESP. The wording of the report implied an important bearing on earlier positive ESP results. It is an important question for research in general whether such a negative report has any generalization value.

Failure to confirm previous reported results is an important finding when the essential conditions are replicated. Such exact replication is seldom attainable in a field so complicated with uncontrolled variables as psychology. In addition, Smith and Canon did not even pretend to replicate any previous research; there was almost no similarity to any experiment that has yielded positive results on ESP.

ESP is recognizably difficult to demonstrate, and no one claims to know how it can be reliably produced on demand. The phychological conditions essential to its functioning are only slowly emerging from the studies of recent years. Under such circumstances, failure to approximate previous results may have no significance.

The Smith and Canon experiment was, unfortunately, not well designed as a research in ESP. The problem was new to the authors, and when Canon wrote me about his plan I replied with a four-page analysis from which I quote:

> Merely to carry through your experiment as it is designed and get the chance results that I should expect you to get would not prove anything except just to add another confirmation of the wrong way to approach an unfamiliar field.

One of the faults I indicated lay in the curious device of making all the targets (or stimuli) to be identified by the subject *of one kind*—an unnecessary deception that went against all rational expectation on the part of the participating subjects. Another grave error lay in the unpsychological disregard of the elusive character of ESP and of the special need, therefore, to provide the test participant with conditions known to be favorable to the demonstration of the ability.

Naturally, I offered to help Canon to design a better experiment. One of the suggestions made was that he first become acquainted with what had already been learned about how to stimulate subjects to perform most effectively in controlled ESP tests. Emphasis was laid on the need for arousing strong interest or motivation. A warning was also given on a statistical handicap in his design, one that involved the risk of a serious "stacking error" when the same target sheet is used in testing a large number of subjects.

In any case, no single negative experiment could be important today against the vast accumulation of positive evidence for ESP in the 18 volumes of the *Journal of Parapsychology* and elsewhere. Such an experiment proves nothing about such researches as, for example, the well-known Pratt-Woodruff (*2*) or the Soal-Goldney (*3*) ESP series. However, it *is* important for the future of any branch of science that the standards of evidence be as strict in *criticism* of new findings that conflict with old ways of thinking as in the *establishment* of such new findings.

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