SCIENCE

11 March 1960

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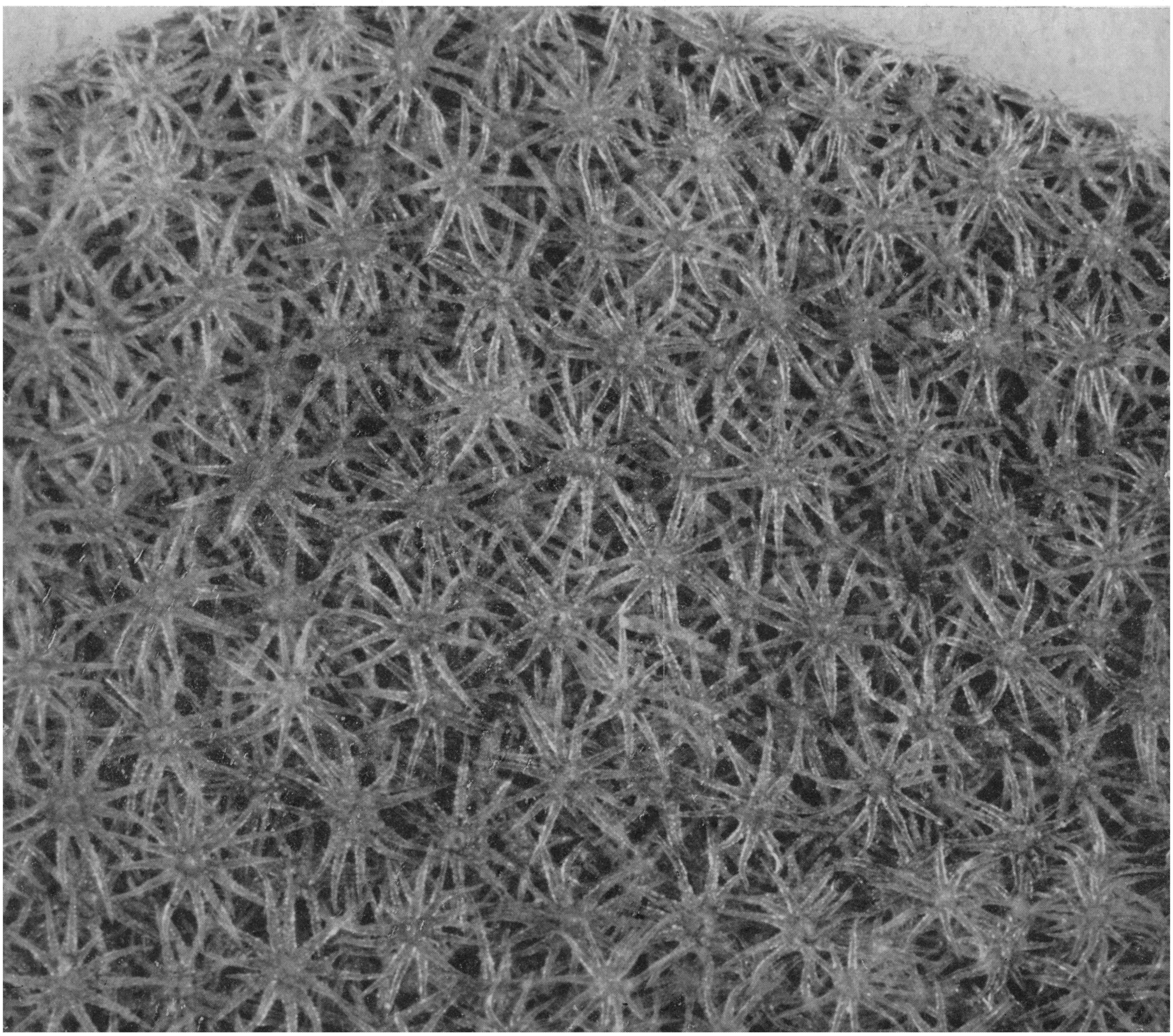
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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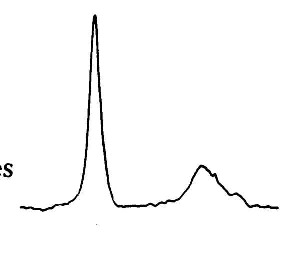

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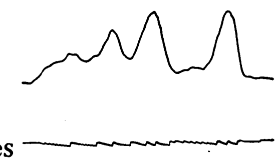

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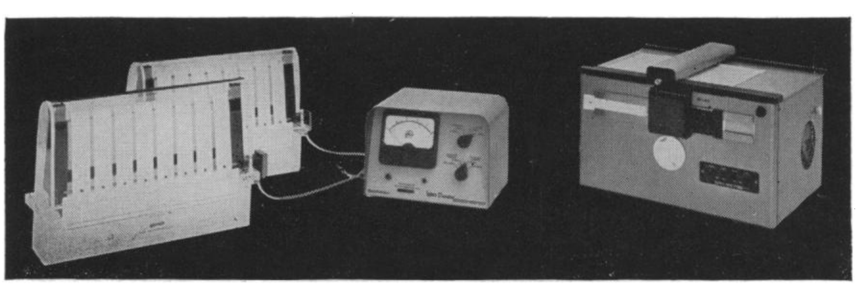

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11 March 1960, Volume 131, Number 3402

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Cover Trichomes, several layers thick, on the surface of a leaf of *Lesquerella ovalifolia*, a species of the mustard family (Cruciferae) (× 44). Each highly branched trichome is a single dead cell that matures early in leaf development. The dense layer of trichomes is highly refractive, and the leaf is silvery in appearance. *Lesquerella ovalifolia* grows in arid areas in southeastern Colorado, western Kansas and Oklahoma, and northwestern Texas. [Courtesy Reed C. Rollins]

Letters

The Moon Illusion

In the paper entitled "Magnitude of the moon illusion as a function of the age of the observer" [*Science* **130**, 569 (1959)], H. Leibowitz and T. Hartman stated, "The diminution in the apparent size of an object when viewed overhead as compared with its apparent size in the horizontal plane is greater for children than for adults." They suggested in explanation, "Since children have less experience with distantly viewed objects, especially when viewed directly overhead, the magnitude of the moon illusion is greater the younger the observer." One is not justified, I believe, in assuming that the horizontal "moon" is correctly perceived while the perception of the overhead moon is in error. It is just as reasonable to assume that the size of the overhead "moon" is correctly perceived but the horizontal "moon" is erroneously perceived as being larger than actual size. In this case the explanation of more experience with horizontal objects and therefore better accuracy in judging their size would be contradicted by the experiments of Leibowitz and Hartman.

Furthermore, since some visual cues occurred in these experiments, even in the darkened but not completely dark theater, the explanation of the moon illusion referred to by Thomas Reid seems more credible. "We frequently perceive the distance of objects by means of intervening or contiguous objects, whose distance or magnitude is otherwise known. . . . An object placed upon the top of a high building, appears much less than when placed upon the ground, at the same distance. When it stands upon the ground, the intervening tract of ground serves as a sign of its distance; and the distance, together with the visible magnitude, serves as a sign of its real magnitude. But when the object is placed on high, this sign of its distance is taken away: the remaining signs lead us to place it at a less distance; and this less distance, together with the visible magnitude, becomes the sign of a less real magnitude. Dr. Smith hath observed, very justly, that the known distance of the terrestrial objects which terminate our view, makes that part of the sky which is towards the horizon appear more distant than that which is towards the zenith. Hence it comes to pass, that the apparent figure of the sky is not that of a hemisphere, but rather a less segment of a sphere. And, hence, likewise, it comes to pass, that the diameter of the sun or moon, or the distance between two fixed stars, seen contiguous to a hill, or to any distant terrestrial object, appears much greater than when no such object strikes the eye at the same time" [T. Reid, *The Works of Thomas Reid, D.D.*, W. Hamilton, Ed. (Longmans, Brown, Green, and Longmans, London, new ed., 1846), sec. 22].

Lastly, the increase of the illusion with distance of the object from the eye may be due to the loss of significant information for depth perception which might ordinarily arise from the ciliary muscles of accommodation. This is reasonable because the adjustments of the ciliary muscles for objects at distances greater than about 30 feet appear to be insignificant.

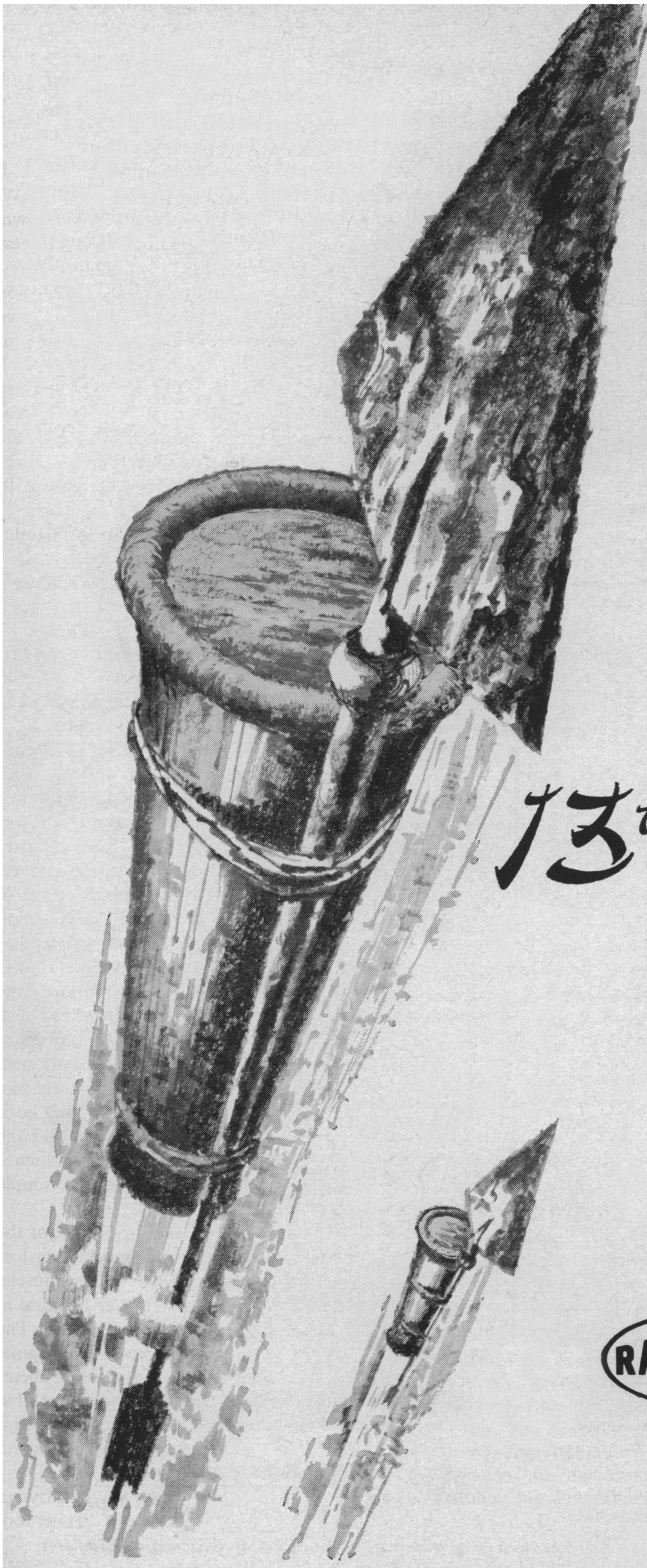
LEONARD A. COHEN
Department of Physiology and Pharmacology, University of Pittsburgh, Pittsburgh, Pennsylvania

The point raised by Cohen in the first paragraph of his letter has previously been discussed [*Science*, **131**, 238 (1960)].

The point raised by Thomas Reid's explanation is logical but was not supported by the verbal reports of our subjects. Most of them expressed surprise when they were informed, after completion of the testing, that the overhead and horizontal stimuli were in fact at the same distance. Their opinion was that the overhead disk was farther away than the horizontally viewed comparison stimuli. Furthermore, the building from which the overhead disk was supported provided a number of cues to distance—for example, perspective and relative size—which were not present to the same degree for the horizontal stimuli. It would seem that the judgment of distance does not influence size judgments in a direct or simple manner.

If the change in the magnitude of the illusion were directly dependent on loss of information from the ciliary muscle, one would expect no further increase at distances beyond 20 or 30 feet. The data of Schur, referred to in our original article, would argue against Cohen's interpretation, for she discovered that the magnitude of the effect was influenced by variation of distance beyond this point.

H. LEIBOWITZ
T. HARTMAN
University of Wisconsin, Madison



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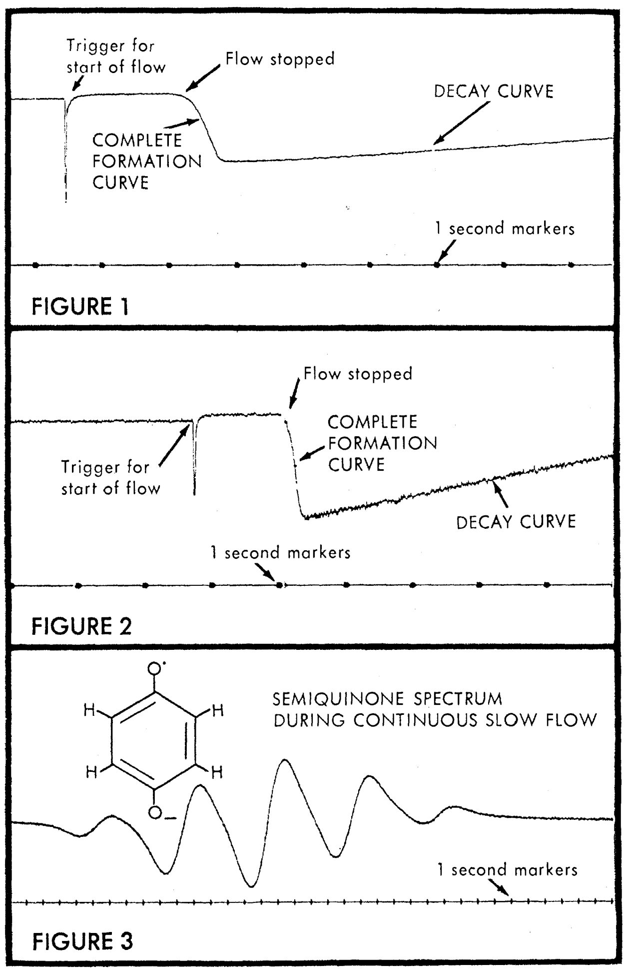

FIGURE 1

FIGURE 2

FIGURE 3

In the past, two techniques utilizing EPR have been used to study the kinetics of free-radical reactions. One method involves relating some change in the spectral features of the resonance lines with the rate of the reaction, (i.e. rapid electron exchange reactions), while the second technique uses the EPR spectrometer as a means for monitoring the time rate of change of concentration of free-radical intermediates formed in the reaction. This latter technique has generally been applicable only to very slow reactions, (i.e. half lives of 10-20 minutes).

Now it is possible to combine this second technique with liquid flow systems so as to study rapid free-radical reactions with half lives as short as 10 milliseconds. In such experiments the EPR cavity serves as both a reaction vessel and detecting head. Both continuous flow and stopped flow experiments may be performed. In stopped flow experiments one flows the two reacting reagents through the detecting head (in this case the EPR cavity) faster than the formation rate of the free-radical intermediates. The flow is then stopped and free radical formation is observed in the cavity. Figures 1, 2, and 3 illustrate the application of a stopped flow system for studying the rate of formation of the semiquinone of hydroquinone. In figure 1, 10^{-3}M hydroquinone in alcohol and an alkaline alcohol solution with a limited concentration of O_2 were fed into the mixing chamber and then passed into the sample cell in the cavity at a flow rate of 6 cc/sec. The trace was obtained by adjusting the magnetic field so that the signal would be at its maximum. The left-hand marker on figure 1 indicates where the flow was started, zero concentration of free radical being observed in the cavity. The second marker indicates where the flow was stopped and the formation of the semiquinone begins. Subsequently the entire formation curve was traced out. The half life for this reaction is 0.5 seconds.

Figure 2 illustrates how the formation rate is increased when the solutions are saturated with O_2. (Half life 0.15 seconds.) Figure 3 shows the complete spectrum of the intermediate obtained during continuous flow and allows one to identify the intermediate as the semiquinone.

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Zero Tolerance

At a date still to be set for sometime next month, the House Committee on Interstate and Foreign Commerce will assemble a panel of scientists for hearings on food additives. The use of cancer-inducing substances (carcinogens) as food additives, which has been brought prominently to public attention by the recent cranberry incident and the barring from the market of fowl treated with a synthetic female sex hormone that can induce cancer under laboratory conditions, will undoubtedly be a major issue.

Central to this issue is the controversial "Delaney clause" of the 1958 amendment to the Food, Drug and Cosmetics Act, which prohibits the use as a food additive of any substance that "is found to induce cancer when ingested by man or animal, or if it is found, after tests which are appropriate for the evaluation of food additives, to induce cancer in man or animals. . . ." The effect of this clause is to put carcinogens in a different category from that of other toxic substances. For such other substances, tolerances may be established after appropriate testing or on the basis of long experience with their use in foods. But the Delaney clause, as it has been interpreted by Secretary Flemming of the Department of Health, Education, and Welfare, sets a "zero tolerance" for any substance that can be shown to induce cancer when fed to animals in any amounts over any period of time. Opponents of the clause in the food and chemical industries, and many scientists who have no industrial axes to grind, call the clause "unworkable" and "unrealistic." They contend that the clause prevents the exercise of scientific judgment about safe levels of carcinogens in foods.

Those scientists and others who favor the Delaney clause justify putting weak carcinogens—strong carcinogens are not in question—in a special category on several grounds. Weak carcinogens usually take a long time to have an effect, and even then they induce few cancers. Furthermore, in the present state of our knowledge, it is not possible to say with absolute assurance that even a small dose of a weak carcinogen will not initiate irreversible cellular changes that may lead to the formation of cancer in man long after exposure.

For an ordinary toxic substance, the effects are rapidly manifested and are reversible. Consequently, thresholds of action for an ordinary toxic substance in animals can be readily determined, and the limit for human consumption can be set at some small fraction (1/100 or less) of the no-effect level for the most susceptible animals tested.

For a weak carcinogen, on the other hand, the long latent period and the infrequency of response make the determination of a threshold far more difficult: many more animals must be treated for much longer periods before reasonable estimates of hazards may be made. The task is difficult, but surely not impossible. What is needed is far more systematic animal experimentation with weak carcinogens, administered orally and in amounts that suffice to establish dependable dose-response relations.

These considerations and others too complex to be considered here will give the scientific panel a difficult job. We hope the panel will be able to suggest the most effective means of bringing scientific judgment to bear upon the provisions of the Delaney clause.—G.DuS.

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the question of whether or not instrumentation people really need ultra-fast film ... a new gravimetric reagent for potassium ... a gimmick the committee needn't resist ... new hope for those who can't get enough light for Kodachrome Film, Type A

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The Japanese have developed a new gravimetric reagent for potassium which we now offer as *N-(2,4-Dinitro-1-naphthyl)benzenesulfonamide* (Eastman 7828). And regardless of how scarce are good gravimetric reagents for potassium that can be used even in the presence of one-third as much sodium and magnesium as potassium, if that numeral in front of the "naphthyl" in the name had been 2 instead of 1, we would not offer it as Eastman 7828 or Eastman anything else. Our medical director feels so strongly about the carcinogenic properties of β-naphthylamine that it would seem wiser to let the science of chemistry go shift for itself than to observe the safety precautions he demands before he will let it into the plant. Pure α-naphthylamine is OK, as far as we know.

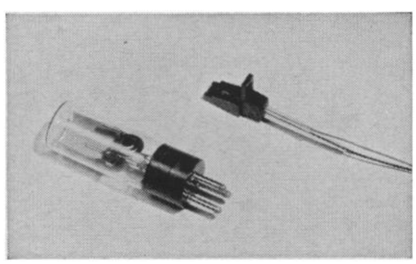
You dissolve the new reagent in lithium chloride solution and use it for the precipitation and conductometric titration of potassium. The precipitated potassium salt of the reagent is washed with the saturated solution of potassium salt and dried at 100°C for an hour. As for the fine details of the procedure, you can either buy 10 grams of Eastman 7828 from us for $4.45 and work them out for yourself, or you can first read up on them in *Nippon Kagaku Zasshi*, *79*, 598 (1958).

When you're ready, you send your $4.45 to Distillation Products Industries, *Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company). In case you didn't know, there are some 3800 other Eastman Organic Chemicals on the shelf there.*

Silicon over the sound track

Quietly, Kodak Pageant Sound Projectors have stolen a march, scored a scoop in their field. You have heard of the "solar battery" which generates useful electrical power when light falls on silicon? The power source for communication from satellites and interplanetary space? Here it is, in over-the-counter civilian hardware, doing a product-improvement job that is apparent even to those who can resist the temptation of a gimmick. If you are on a committee to select a sound movie projector for audio-visual instruction, the facts to lay before your fellow committeeman are these:

Early attempts at sound movies through a variable light pattern on the film employed selenium cells. They foundered. An EMF-generating selenium cell (not to be confused with a device that changes resistance in response to light) has an inherently slow time constant for adequate frequency response. The movies had to wait for the evacuated phototube to give them a good voice.



At left is a phototube such as employed today in most sound projectors. Being a little bulky, light that has passed through the sound track of the film must be somehow transmitted to it. At right is the new silicon "solar" cell. It holds 0.014 square inch of silicon directly above the sound track. It therefore requires a less critical optical arrangement. More important, it generates a varying EMF instead of valving from a constant EMF that must be supplied to it. This considerably simplifies the circuitry. There is less to get out of whack. Also, a solid-state generator happens to generate less random fluctuation than a photocathode system that must be kept under electrical tension. Less "white noise" shows up at the speaker. The old trouble from inadequate frequency response with selenium is gone.

If the old boys had known enough solid-state physics to place their bets on silicon instead of selenium, people with vivid memories of the silent movie queens would be even older, on the average, than they feel as it is.

We are talking about Kodak Pageant Sound Projectors, Models 8K5, AV-085, *and* AV-255-S. *Your local audio-visual dealer will take it from here.*

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The world is crazy. It flagellates itself into technological advances on the pretext of military preparedness. For this, nothing is too much trouble. If it finds one such advance to be applicable to peaceful purposes, such as the healing arts, it is as happy as an idiot who in his rage has turned up a pretty pebble.

Ektachrome ER Film has recently been brought out under pressure of the missile industry, which needs color film of very high sensitivity for the high speed movie cameras they use in their testing work. Could anybody else use such a film? Yes, come to think of it.

Physicians interested in endoscopic color photography might find it useful. To get enough light for good color photography into the cavities of the living body has been difficult. Motion pictures, which afford the possibility of thorough scanning of an area with a large number of individual images, better the chances for decisive demonstration.

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6. The Allergic Child, symp., New Haven, Conn. (V. L. Szanton, Hospital of St. Raphael, New Haven 11.)

6–8. Biochemistry and Pharmacology of Compounds Derived from Marine Organisms, symp., New York, N.Y. (R. F. Nigrelli, Dept. of Marine Biochemistry and Ecology, New York Aquarium. Seaside Park, Eighth St. and Surf Ave., Brooklyn 24, N.Y.)

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6–8. Radiofrequency Spectroscopy Group, Nottingham, England. (J. E. Ingram, RSG, c/o Dept. of Electronics. Telecommunications and Radio Engineering, Univ. of Southampton, England.)

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7–8. Municipal and Industrial Waste, 9th southern conf., Raleigh, N.C. (C. Smallwood, Jr., North Carolina State College, Extension Div., Box 5125, Raleigh.)

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8–9. Southern Soc. for Philosophy and Psychology, Biloxi, Miss. (E. Henderson, Florida State Univ. Tallahassee.)

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9–10. Histochemical Soc., 11th annual, New York, N.Y. (H. W. Deane, Albert Einstein College of Medicine, Bronx 61, N.Y.)

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11–15. Federation of American Socs. for Experimental Biology, Chicago, Ill. (M. O. Lee, 9650 Wisconsin Ave., NW, Washington 14.)

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12–13. Microbial Genetics, symp., London, England. (B. W. Lacey, Soc. for General Microbiology, Dept. of Bacteriology, Westminster Medical School, London, S.W.1.)

13–15. American Public Health Assoc. (Southern Branch), Memphis, Tenn. (L. M. Groves. Shelby County Health Dept., Memphis.)

15–16. Eastern Psychological Assoc., New York, N.Y. (C. H. Rush, Standard Oil Co. (N.J.), Rockefeller Plaza, New York, N.Y.)

16. Pennsylvania Acad. of Science, Williamsport. (K. B. Hoover, Messiah College, Grantham, Pa.)

18–19. Radioactivity in Man, Measurements and Effects of Internal Gamma Ray Emitting Radiosotopes, AAAS symp., Nashville, Tenn. (G. R. Meneely, School