was probably the best observed eclipse of the Moon in the history of science. It also brought about the highest degree yet attained in the cooperation of state, church, commerce and science in a single scientific problem. The Canadian and the United States Weather Services, the United States Army Signal Corps, the Roman Catholic Eskimo Mission, the fur traders and trappers along the Arctic Circle, the Royal Canadian Mounted Police, the powerful radio broadcasting stations of the Westinghouse Company, the astronomers of the observatories in western and southwestern America, the newspapers and Science Service, and the amateur astronomical observers over a large part of the United States were all involved in various phases of the meteorological and astronomical observations of this eclipse.

It will be many months before all reports come out of Alaska and from the Canadian Arctic giving information concerning the character of the atmosphere where the grazing solar rays passed and were refracted into the Earth's shadow cone to illuminate faintly, and discolor, the eclipsed Moon.

The general plans for the eclipse observations were developed by Dr. W. J. Fisher, of the Harvard staff, who has specialized in phenomena associated with lunar eclipses; the Canadian work was organized through the efficient cooperation of Dr. R. M. Stewart, director of the Dominion Observatory at Ottawa.

Nova in Magellanic Cloud. A nova in one of the Clouds of Magellan is of more than passing interest. In the first place, such an object has not heretofore been found in either of the Magellanic Clouds, notwithstanding the presence there of practically all other known types of high luminosity stars. In the second place, the distance of the Clouds are known, and therefore the actual luminosities of novae in such places can be computed, which is far from being the case for the nearer novae in our own Milky Way.

While comparing two photographs of the Large Cloud, in a study of stellar motions, Dr. Luyten recently noticed on a plate taken last September a star that was wholly absent from all of the many earlier plates. A search showed its images on eight other plates taken between September 28 and November 6. Just after this last plate was taken the Arequipa telescopes were dismantled for transfer to the new station in South Africa, and the further behavior of the star is unknown.

A cablegram to the South African observatories has resulted in some special photographs being made at the Union Observatory, Johannesburg, but the nova has apparently already disappeared. At maximum brightness the star was difficult enough, being photographically of the twelfth magnitude. But actually, if it is a member of the Magellanic Cloud, it was, when brightest, some ten thousand times as bright as the Sun; the distance accounts for the apparent faintness. And while we are speaking of actualities we should add that it was only the terrestrial recording of a nova that occurred last September—the actual disaster happened nearly a thousand centuries ago.

HARLOW SHAPLEY

SPECIAL ARTICLES

FURTHER STUDIES ON THE ANTIRACHITIC ACTIVATION OF SUBSTANCES BY CATHODE RAYS[1]

IN a previous preliminary report[2] it was shown that, with the exposures used, high-voltage cathode rays[3] applied directly were not effective in healing rickets in rats. On the other hand, it was shown that cholesterol could be endowed with antirachitic potency by exposure to the cathode rays. In our earlier attempt cholesterol was exposed to the cathode rays in a rather thick film and had to be added to the diet in amounts of 0.2 per cent. or more to bring about within two weeks complete healing of rickets in rats, which were rendered antirachitic by the Steenbock rachitic diet No. 2965.[4]

We have since found that, with the film of the substance about a millimeter or less, just as active products are formed by exposure to cathode rays as with ultraviolet irradiation and moreover the time interval is much shorter. In Tables I and II are summarized some of the recent experiments carried out. The cathode ray exposure was in all cases at a distance of 1 inch from the window of the tube and a current of 1 milliampere and 200,000 volts used. The substances were exposed in air and in one instance in an atmosphere of nitrogen. The cholesterol used in these experiments was a commercially pure product. In the experiments with cholesterol purified by the dibromide method, it was first brominated, then debrominated, brominated a second time, again debrominated and finally recrystallized three times from hot alcohol.

From an examination of Table I it is seen that cholesterol exposed to cathode rays for 30 seconds is ef-

[1] From the Laboratory of Biological Chemistry, Albany Medical College, and Research Laboratory, General Electric Company, Schenectady, N. Y. The writer is greatly indebted to Dr. W. D. Coolidge for his valuable advice and assistance, and for the technical assistance of F. S. Randles and H. E. Tanis, Jr.

[2] Knudson, Arthur, and Coolidge, W. D., *Proc. Soc. Exp. Biol. and Med.*, 1927, XXIV, 363.

[3] Coolidge, W. D., *Jour. Franklin Institute*, 1926, ccii, 693.

[4] Steenbock, H., and Black, A., *Jour. Biol. Chem.*, 1925, lxiv, 263.

TABLE I

EFFECT OF CATHODE RAY EXPOSURE ON ANTIRACHITIC ACTIVITY OF CHOLESTEROL

No. of rats	Experimental period, days	Test material	Length of exposure	Amount in diet or daily dose	Results shown by radiographic examination
			seconds		
2	14	Cholesterol, commercial	30	0.05%	Moderate healing
2	14	"	0	0.3 %	No healing
2	14	"	30	0.25%	Moderate
2	14	"	30	0.25%	Beginning
*2	14	"	30 in N	0.25%	Beginning to moderate
2	14	"	30	0.01%	Beginning to moderate
2	14	"	900	0.03%	Moderate
2	14	"	30	1 mg. daily	Beginning
1	14	"	30	2 mg. daily	None
1	14	"	30	2 mg. daily	Advanced
**2	14	"	U. V. 30 min.	2 mg. daily	Advanced
2	14	Cholesterol, purified by dibromide method	30	2 mg. daily	No healing
1	14	"	30	4 mg. daily	"
2	14	"	30	0.05%	"
**2	14	"	U. V. 30 min.	2 mg. daily	"

TABLE II

EFFECT OF CATHODE RAY EXPOSURE ON THE ANTIRACHITIC ACTIVITY OF INERT SUBSTANCES

No. of rats	Experimental period, days	Test material	Length of exposure	Amount in diet or daily dose	Results shown by radiographic examination
			seconds		
2	14	Dry brewers' yeast, Harris	30	25 mg. daily	Complete healing
2	14	"	0	25 mg. daily	No healing
2	14	Special dry yeast, Fleischmann	30	10 mg. daily	Complete
2	14	Dry brewers' yeast, Harris	30	5 mg. daily	"
2	14	"	30	1 mg. daily	Advanced
1	14	"	30	2 mg. daily	"
2	14	Special dry yeast, Fleischmann previously extracted one week with ether	30	10 mg. daily	"
*2	14	Corn-starch	30	6 per cent.	None
2	14	Cottonseed oil	90	0.1 cc. daily	Moderate
2	14	" "	0	0.1 cc. daily	No healing

fective in bringing about healing of rickets in doses of 1 or 2 mg per day. Exposure for as long as 900 seconds does not destroy the antirachitic potency. It is also seen that cholesterol purified by the dibromide method can not be rendered antirachitic by either cathode ray exposure or ultraviolet radiation. This result confirms those of Hess and Windaus,[5] and Rosenheim and Webster,[6] who were unable by ultraviolet radiation to activate cholesterol when thus purified.

* Cathode ray exposure in atmosphere of nitrogen.

** Ultraviolet radiation with Victor Mercury vapor lamp for 30 minutes at a distance of 1 foot.

[5] Hess, A. F., and Windaus, H., *Proc. Soc. Exp. Biol. and Med.*, 1926, XXIV, 171.

[6] Rosenheim, O., and Webster, T. A., *Jour. Soc. Chem. Ind.*, 1926, 45, 932.

In Table II, it is seen that yeast, starch and cottonseed oil can also be activated by exposure to cathode rays. The experiments with yeast are extremely interesting. Yeast which contains ergosterol, considered to be the provitamin of vitamin D,[7] is rendered very potent by exposure to cathode rays. With an exposure of 30 seconds, a dose of 1 mg daily brings about advanced healing of rickets within two weeks. Compared with a good grade of cod liver oil this is at least 10 to 20 times more potent. It is also interesting to note that a yeast which had been extracted previously for one week with ether in a continuous Soxhlet type of apparatus was still rendered very potent, indicating that the substance which is

* The line test showed beginning healing and the cornstarch in this case was exposed in rather thicker film than usual.

[7] Rosenheim, O., and Webster, T. A., *Biochem. Jour.*, 1927, XXI, 389.

rendered antirachitic is not readily extracted with ether.

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THE DEVELOPMENT OF MORE EFFECTIVE DUST FUNGICIDES BY ADDING OXIDIZING AGENTS TO SULPHUR

SUGAR-CANE fields in Hawaii can not be treated effectively with liquid fungicidal sprays, because the matted cane growth prevents passage of men or work animals through a field. For this reason we have attempted the use of fungicidal dusts which can be applied to the cane from the edges of the fields by motor-driven dusting machines or by airplanes.

The problem we are working with is a serious infectious leaf and top disease of the cane, called eye spot, caused by the fungus *Helminthosporium sacchari* Butler. Our first attempts against this disease were ineffectual, not from any difficulty in placing the dust on the cane but because the fungicidal dusts used caused little or no reduction of the disease. In field-plot tests with adequate replications Bordeaux dust, and other copper mixtures, organic-mercury mixtures, sulphur mixtures, chlorine mixtures and coal-tar disinfectants gave little or no control of the disease. The best result in these earlier attempts was in plots treated with ordinary dusting sulphur in which we obtained 27 per cent. less infection than in alternating untreated plots which served as controls. This reduction of the disease was not sufficient to recommend for plantation practice but was sufficient to encourage us to seek further for more effective compounds.

Previous research by Young[1] showed that the fungicidal action of sulphur was due to the formation of pentathionic acid formed by oxidation in the air. Young went further with this and secured greater fungicidal action by using more finely divided sulphur which would adhere to foliage better and oxidize more readily. Young's conclusions have been questioned in England,[2] however.

The slight reduction of our disease with dusting sulphur nevertheless led us to follow up Young's work; instead of depending upon the oxidizing effect of the air, such oxidizing agents as nitric acid, one fourth of one per cent., and pulverized potassium permanganate, 1 per cent., were added to the sulphur. Seven plots of cane treated with the latter mixture have shown a reduction of 89.9 per cent. of infections as compared with seven undusted plots as controls; at the same time finely divided sulphur on seven plots has reduced the number of infections but 9 per cent. Sulphur plus one fourth of one per cent. nitric acid in eight similar plots reduced the disease 61 per cent. We have since increased the effectiveness of the oxidized sulphur even further by increasing the concentration of potassium permanganate to 5 per cent. No burning of sugar-cane foliage resulted, even when the concentration of potassium permanganate was increased to 10 per cent.

Potassium permanganate in a non-sulphur carrier such as kaolin has not reduced the disease as compared to untreated cane in control plots, indicating that the fungicidal effect is not due to the direct effect of the permanganate as a disinfectant but to its oxidizing effect on the sulphur.

It is possible to get quantitative data on the results of our treatments by marking an equal number of cane stalks in each plot and having counts of infections per leaf made at two-week intervals. The figures given above are from 140 leaf counts per treatment.

At the same time that our oxidized sulphur preparations gave a good control of the disease, we received a stimulation of growth, apparently independent of the disease-control, as shown by growth measurements of 70 cane stalks per treatment. The total increased growth was 8.8 inches per stalk, which would mean from two thirds to three fourths ton of sugar more per acre, a very profitable increase in yield.

It is our impression that dust fungicides against plant diseases have generally been less effective than liquid fungicides and that some of the sales of fungicide dust mixtures have been made by high-pressure salesmanship rather than on the basis of proven results in the field. We believe that our oxidized-sulphur mixtures will place fungicidal dusts more nearly on a competitive basis with liquid sprays, with the added advantage of greater economy of application. Care must be taken to keep these mixtures dry and away from fire, but millions of people have learned that gasoline can be used, with a few ordinary precautions.

Concerning mixtures of oxidizing agents in sulphur as fungicides, a patent has been applied for and if any royalties do occur they will be applied for the furtherance of research.

H. ATHERTON LEE
J. P. MARTIN

EXPERIMENT STATION OF THE
HAWAIIAN SUGAR PLANTERS'
ASSSOCIATION

[1] Young, Harry Curtis. "The Toxic Property of Sulphur." Annals of the Missouri Botanical Garden, Vol. IX, p. 403, 1922.

[2] The Association of Economic Botanists. Discussion on "The Fungicidal Action of Sulphur." Ordinary Meeting, Oct. 20, 1925; *The Annals of Applied Biology*, Vol. 13, No. 2, p. 308, May, 1926.