The legal research committee, headed by George Welwood Murray, sponsored studies in administrative law and legal history.

The fund continued to offer a group of fellowships for British graduate students at American universities, 31 having been appointed this year to spend two years in this country as guests of the fund. The distinguished physicist, William Lawrence Bragg, of the University of Manchester, has been elected to the British Committee of Award which selects these fellows, succeeding Sir Hector Hetherington, vice-chancellor of the University of Glasgow.

Appropriations were made for the training of psychiatrists and psychiatric social workers as a contribution to the progress of mental hygiene in the United States. The fund shared in the support of a central bureau of information about child guidance, under the auspices of the National Committee for Mental Hygiene, and of a study of psychiatric education. Gifts were made to the Welfare Council and to the Family Welfare Committee of New York City.

At the close of the fiscal year, September 30, 1936, the invested assets of the fund had a book value of $42,607,226.31 and a market value of $41,039,182.93. The directors of the fund are as follows: Edward S. Harkness, president; Malcolm P. Aldrich, Samuel H. Fisher, William M. Kingsley, Robert A. Lovett, George Welwood Murray and Dean Sage.

SPECIAL ARTICLES

A CRYSTALLINE VITAMIN A CONCENTRATE

THE non-saponifiable matter from the liver oil of *Stereolepis ishinagi*[1] was dissolved in a suitable solvent and fractionated by freezing at carbon dioxide snow temperatures. A final product, quite distinctly crystalline to the naked eye, was obtained. This material had the rather remarkable value of $E^{1\%}_{1\,cm} = 2{,}000$ (as determined by the Hilger Vitameter-A) while the blue value (determined by antimony trichloride reaction according to the method recommended by the British Pharmacopoeia) was 100,000. It is interesting to note that the ratio between these values is 1 to 50, which is in agreement with the ratio of the rather generally accepted provisional standard values for vitamin A, $E^{1\%}_{1\,cm} = 1{,}600$ and blue value = 80,000 (approx.).

The melting point of the pale yellow crystals was determined by evacuating at low temperatures to remove the last traces of solvent and then *very* gradually warming the cooled bath surrounding the melting point tube. To retard this rise in temperature the bath liquid was placed in a Dewar flask (transparent). The melting point ranged from 5.5° C. to 6° C., a rather satisfactory range since the resulting yellow liquid, or melt, is very viscous even at room temperatures. It is obvious that great accuracy in the determination of the melting point is difficult because of the high viscosity of the liquid.

After standing twenty-four hours with von Hubl's solution, the iodine number was 360, which corresponds to four double bonds; longer standing produced a slightly erratic increase in the iodine number. It is probable that addition to the double bond in the ionone ring is difficult.

Purely preliminary quantitative determinations of carbon and hydrogen in this product seem to indicate a carbon content of approximately 83.5 per cent. and a hydrogen content of approximately 10.5 per cent. (with remaining fraction ascribed to oxygen); these values will be corrected at an early date. Molecular weight determinations as well as biological tests are in progress and will be reported later.

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[1] Ishinagi liver oil furnished through the courtesy of the Mead Johnson Company.

STREAM DOUBLE REFRACTION OF PREPARATIONS OF CRYSTALLINE TOBACCO-MOSAIC PROTEIN

PREVIOUS experiments[1] have indicated that under certain conditions the concentration of tobacco mosaic virus in plant juice shows a high positive correlation with the intensity of stream double refraction produced by the juice. These results and others have indicated that the virus in plant juice may be composed of submicroscopic rod-shaped particles capable of causing stream double refraction.

Stanley[2] has obtained crystal preparations from infective juice which contain a high concentration of virus and has obtained considerable evidence that these crystals are the virus in a crystalline state. We have prepared crystals by means of Stanley's method and by a combination of certain steps in Vinson and Petre's[3] and Stanley's methods. Space does not permit giving the details of this combination method. For brevity the crystals prepared by Stanley's method will be called "Stanley crystals" and those prepared by the combination method "C crystals." It was found that the use of a Zeiss cardioid dark field condenser in

[1] W. N. Takahashi and T. E. Rawlins, SCIENCE, 81: 299–300, 1935.

[2] W. M. Stanley, *Phytopath.*, 26: 305–320, 1936.

[3] C. G. Vinson and A. W. Petre, *Bot. Gaz.*, 87: 14–38, 1929.

the microscope enables one to observe the structure of the crystals much better than is possible when a bright field condenser is used. The Stanley crystals were needle-shaped, appeared to have a granular structure and were admixed with a relatively small number of spheroidal particles. The "C" crystals were also needle-shaped, but were smooth in outline; this preparation appeared to contain fewer spheroidal particles than the Stanley preparation. The spheroidal particles were detected only when the dark field condenser was used. The optical activity of each preparation was determined; that of the Stanley preparation was found to be $[\alpha]_D^{22°}$ per mg nitrogen $= -38$, and that of the "C" preparation was -40. Stanley[2] reported the optical activity of his two samples of crystals to be -42 and -44. The fact that these 4 results are reasonably close, that the crystals are small needles similar to those of Stanley and that the virus concentration in these preparations is high indicates that these crystals are composed of the same material as those obtained by Stanley.

It was found that suspensions of the visible crystals in ammonium sulfate solution produced stream double refraction and that colloidal solutions of the crystals in buffers also showed this phenomenon. As much as 96 parts of buffer solution could be added to 1 part of the suspension of crystals before the solution reached the critical dilution. (The critical dilution is that dilution at which stream double refraction becomes undetectable.) By means of the first order red plate of the polarizing microscope it was found that the vibration direction of the slow ray of polarized light was always parallel to the direction of flow. This relation has also been observed in unpurified virus preparations. If these crystal preparations are pure virus, as many assume, it must be concluded that the virus can exhibit stream double refraction and, when in solution, is probably composed of submicroscopic rod-shaped particles.

Determinations were made of the critical dilution and active virus concentration in solutions of both of the crystalline preparations and in unpurified virus. The influence of pH on critical dilution and on active virus concentration was also determined. The number of local lesions produced on *Nicotiana glutinosa* L. was used as an indicator of active virus concentration. It was found that a given sample of virus produced approximately 14 per cent. more local lesions when at pH 7 than at pH 5.6. Conversely, a given sample of virus at pH 7 had a critical dilution approximately 36 per cent. lower than at pH 5.6. In other words, the number of local lesions produced was higher and the stream double refraction lower at pH 7 than at 5.6. These relations were found to hold for unpurified virus as well as the crystal solutions. As a hypothesis to explain this relation we would suggest that the virus is peptized at the higher pH and that more particles are therefore available to cause local lesions. To account for the lowered stream double refraction at pH 7 we would suggest that the refractive index of colloidal particles is probably lower at pH 7 than at 5.6; this should decrease the stream double refraction.

When stream double refraction is being used to determine the concentration of active virus the unknown and control should, as may be inferred from the above results, always have the same pH.

When solutions of crystals were diluted to the critical dilution the solution of Stanley crystals produced about twice as many local lesions as the solution of "C" crystals. When a critical dilution of unpurified control virus was compared with those of crystal solutions the solution of Stanley crystals produced an average of 24 per cent. less and the solution of "C" crystals 57 per cent. less lesions than did the unpurified virus. If the crystal preparations are pure, these results indicate that a significant portion of the virus in the crystals has become inactive during the purification process and that this inactivation is greatest in the "C" preparations.

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GENES AFFECTING RESPONSE OF NICOTIANA TABACUM HYBRIDS TO TOBACCO-MOSAIC VIRUS

IN *Nicotiana tabacum* L. and *N. paniculata* L. tobacco-mosaic virus (tobacco virus 1, *distorting* strain) causes a mottling-type disease, whereas in *N. rustica* L. and *N. glutinosa* L. the same virus causes necrosis. In a recent paper,[1] it was reported that a dominant gene, controlling necrotic type of response, was transferred from *N. rustica* to a self-fertile derivative of *N. paniculata* by hybridization of the two species, followed by repeated backcrosses to the recessive-type parent, and eventual self-pollinations. In the derived strain of *N. paniculata,* infection induced a necrotic-type, instead of a mottling-type, disease. This gene has now been carried from the necrotic-type strain of *N. paniculata* to plants of $[(N.\ paniculata \times N.\ tabacum) \times N.\ tabacum] \times N.\ tabacum$. There were considerable deviations from 1 : 1 ratios of necrotic-type to mottling-type plants in the backcross generations.

A similar gene for necrotic-type response has been transferred from *N. glutinosa* to three generations of hybrids with *N. tabacum.* All plants gave a necrotic-type response in the first generation hybrid *N. taba-*

[1] F. O. Holmes, *Phytopath.*, 26: 1007, 1936.