enty-eight members of the society. The three following addresses were given by invitation of the Program Committee: "Mathematical Aspects of the Boundary Layer Theory," by Professor K. O. Friedrichs, of New York University; "The Structure of Normed Abelian Rings," by Professor E. R. Lorch, of Columbia University, and "Modern Algebra and the Riemann Hypothesis," by Professor André Weil, of Lehigh University.

AN Institute on Dental Health Economics, of which Dr. Kenneth A. Easlick will be the chairman, will be held from June 26 to July 1 by the School of Public Health of the University of Michigan.

THE Pan American Union has announced the publication of a new series of ten volumes entitled "Higher Education in Latin America," to be issued by the Division of Intellectual Cooperation. The series has been made possible through a grant from the Rockefeller Foundation.

THE National Electrical Manufacturers Association is reported by *Industrial Standardization* to have made arrangements for the distribution throughout Latin America of a large number of copies of a Spanish edition of the National Electrical Code. It is believed that the translation of this code will be helpful in promoting Pan-American cooperation in standardization activities. The documents will be distributed by the office at Buenos Aires of the Inter-American Department of the American Standards Association.

IT is announced that the Textile Research Institute, New York City, has purchased the Morton estate at Princeton, N. J., for conversion into laboratories. The property includes an eighteen-room stone house on the north side of Lake Carnegie. As soon as the necessary changes can be made in the building, the research work of the Textile Foundation, now at the Bureau of Standards, Washington, will be transferred to Princeton. It will continue under the direction of Dr. Milton Harris, who is director of research for both the foundation and for the institute.

IT is reported in the *British Medical Journal* that a Swiss Society for Tropical Medicine has been founded at Berne under the presidency of Dr. P. Thillot, of Lausanne, and that an Institute for Tropical Medicine has been founded at Basle.

ACCORDING to a communication dated April 10 from the Delhi correspondent of *The Times*, London, Professor A. V. Hill, secretary of the Royal Society, who was expecting to return to England after a stay of five months in India, stated that a visit of Indian scientific men to England had been arranged to take place in May. The delegation includes Colonel Batra, deputy Director-General, Indian Medical Service; Sir S. S. Bhatnagar, director of the Board of Scientific and Industrial Research; Sir J. P. Ghosh, of the Bangalore Institute, and two physicists, Professor S. K. Mitra and Professor M. M. Sar, of Calcutta. *The Times* reports that in speaking of the scientific aspect of the national development of India —upon which he had been asked to advise the Government—Professor Hill "emphasized the need of a great increase of scientific education, particularly in the higher stages. That would involve that young Indian scientists, engineers and doctors should go abroad for advanced study and training, and that specialized institutions should be set up in India where people could be trained to the high standards required to-day. The natural resources of India were very great, but nobody knew exactly what or where they were. The zoological survey of India was at present little more than a museum, and the botanical survey had not had a director for the past seven years. He wanted to see more research carried out in the teaching institutions, and a strong central organization for dealing with problems of research. Public health required attention most urgently. According to the last published census returns, 450 children out of every 1,000 died before they reached the age of 15, and too many people in India died from preventable diseases."

ACCORDING to the daily press, an agreement has been reached between China and the United States under which China is to receive American assistance in the development of her agricultural and forestry enterprises. China will send from ten to twenty-five technicians to America for advanced study and practical training, and the United States will appropriate lend-lease funds for the purchase of agricultural equipment for China.

DISCUSSION

STREAM DOUBLE REFRACTION STUDIES ON THE ORIENTATION OF TOBACCO MOSAIC VIRUS PARTICLES

IN earlier publications[1, 2] we reported that sols streaming horizontally from a small tube (.5 mm inside diameter) through a vessel containing the sol show double refraction throughout the width of the stream if the particles are rod-shaped, and only along

[1] W. N. Takahashi and T. E. Rawlins, *Proc. Soc. Exper. Biol. and Med.*, 30: 155, 1932.

[2] W. N. Takahashi and T. E. Rawlins, SCIENCE, 77: 26, 1933.

the edges of the stream if the particles are plate or disk-shaped. It was assumed that in all cases the longest axis of the particles was oriented parallel to the direction of flow, and that the flat surfaces of plate or disk-shaped particles were parallel to the surface of the cylindrical tube. Disk-shaped particles show maximum form double refraction when the transmission direction of the incident light is parallel to the flat faces of the disks and minimum double refraction when perpendicular to the flat faces. Light transmitted in a vertical direction should therefore produce strongest double refraction along the edges of the stream where most of the particles have their flat surfaces vertical and should produce minimum double refraction in the middle portion where most particles in the upper and lower regions of the cylindrical stream have their flat surfaces in a horizontal position.

We have recently modified the technic by using several types of compensators in studying the magnitude of the birefringence and the orientation of particles. Evidence has thereby been obtained indicating that our above conclusions should be modified to some extent. These studies indicate that flowing rod-shaped particles of tobacco mosaic virus do not produce uniform birefringence throughout the width of the stream but show less birefringence in a narrow central portion of the stream than in adjacent regions on each side of the center. In the regions showing strongest birefringence tobacco virus particles were not found to be exactly parallel to the direction of flow but to have their forward ends tilted toward the middle of the stream at an angle (α) of approximately 15° to the direction of flow.

Langmuir[3] studied the stream double refraction of several sols flowing downward within a pipette (8 mm inside diameter). He stated that "the presence of a dark central band is characteristic of particles which are disks or flat plates. Rods become oriented in the direction of flow which is also the direction of shear, and so give transmission over the whole width of the tube. Disks or plates in a non-crystalline liquid should become oriented with their planes parallel to the tube axis, but perpendicular to the radius of the cylinder through the particle, for these planes are tangent to the surface of shear. If the particles are circular disks, they should not change the plane of polarization of light passing through the axis of the tube and thus there should be a black band in the axis when the crossed polaroids are at 45°. If, however, the particles are plates which are longer than they are broad, so that their long axes are oriented parallel to the tube axis, the intensity of the central band should serve as a measure of the ratio of width to length." He observed a tilting of plate-shaped bentonite particles relative to the direction of flow in the edges of the stream within the pipette. Langmuir explained the tilting by assuming that the bentonite particles are oriented in a cubic lattice. When subjected to shear caused by flow he assumed that the position of the particles is changed from the cubic arrangement to a parallelogram arrangement and that the repulsive forces between the particles are modified as a result of the changed arrangement, causing the tilting of the forward ends of the particles toward the center of the stream.

Bernal and Fankuchen[4] were unable, by means of x-ray diffraction methods, to detect any evidence of spacings corresponding to the length of tobacco mosaic virus particles. They therefore assumed from their evidence that the particles in the "virus crystals" are oriented in 2 dimensions but not in the third dimension. Langmuir accepted this interpretation and stated that in very old V_2O_5 sols, "as in tobacco virus solutions, there is probably no regularity of micelle arrangement in directions parallel to their length, so that the forces . . . which cause the tilting are absent. In new V_2O_5 sols, however, the shorter particles permit a three-dimensional rather than a two-dimensional lattice arrangement and so give $\alpha \neq 0$."

We have studied tobacco mosaic virus by means of Langmuir's pipette technique and, as in the stream expelled from the small tube, find a lower birefringence in a narrow central band in the center of the stream than in adjacent regions on each side. Again we also find the tilting of the particles relative to the direction of flow in the most birefringent portions on each side of the central band. This evidence will be given in detail in a later publication.

We would suggest that the unexpected low birefringence observed in the middle of the stream of rod-shaped tobacco mosaic particles is probably due to the particles in the portion of the stream nearest the observer having their forward end tilted away from the observer and those in the portion opposite the observer having their forward end tilted toward the observer. Particles in such positions should produce lower form birefringence than if oriented in a direction parallel to flow.

If Langmuir is correct in assuming that the tilting of particles in a stream is dependent on a 3-dimensional lattice arrangement of the particles the obvious conclusion from our results would be that there is a 3-dimensional orientation of tobacco mosaic particles.

Recent results with the electron microscope[5,6,7] indicate considerable variation in the length of tobacco

[3] *Jour. Chem. Phys.*, 6: 873, 1938.

[4] *Nature*, 139: 923, 1937.

mosaic particles. Approximately 70 to 80 per cent. of the particles have a length close to 3,000 Å; most of the remainder have a length between 750 and 2,250 Å. It is evident from these results that, if there is orientation in the third dimension, the characteristic spacing could be as great as 3,000 Å, a value too great to have been detected by the x-ray technique used by Bernal and Fankuchen.[8] Their x-ray results therefore can no longer be considered evidence against a 3-dimensional orientation of the particles. If there is orientation in the third dimension it would probably be much less perfect than in most crystals because of the variation in the length of the virus particles.

From the above discussion it is evident that our suggestion of a 3-dimensional orientation of tobacco mosaic particles is based on Langmuir's evidence that tilting of particles is dependent on a 3-dimensional arrangement. If the tilting is not dependent on a 3-dimensional arrangement but on other factors mentioned by various workers,[9] assumption of a 3-dimensional orientation of tobacco mosaic virus particles would be unfounded.

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THE INCOMPLETENESS OF SOME ECOLOGICAL GRASSLAND STUDIES

AS an ecological factor in pastures, the wild animal life, consisting mostly of small inconspicuous invertebrates, must at least be considered, even if it is thought not to equal in its effect the feeding of domestic animals, the competition of weeds or the vigor of the different species of the grasses themselves, and the physical environmental factors of topography, soil and climate. The neglect of this factor of the smaller wild animals may lead to serious errors. For, incredible as it may seem, in many a pasture grazed not too close to its carrying capacity, the obvious cows and horses are not as great a bulk as the total weight of insect and other wild animal life existing there. Ants and leafhoppers are especially numerous in grasslands, but because of their small size, the effect of their presence is not so marked as that of grasshoppers, cutworms and white grubs, which eat almost as much of the pasturage as do the domestic animals.[1] The statistical studies conducted on grasslands in England and of a considerable variety of environments elsewhere[2] have, unfortunately, not been carried far enough to show how much each species of insect, spider, millipede, snail, earthworm and nematode adds or subtracts from the vegetation of the area, and what is the total effect of their combined impact. In the numerous studies of grasslands now being conducted because of the value of such areas in soil conservation, no more fruitful project is open, and the failure to include such records of the wild animal life of pastures and meadows is sure to result in a seriously distorted picture.

"An Ecological and Grazing Capacity Study of the Native Grass Pastures in Southern Alberta, Saskatchewan and Manitoba"[3] mentions not a single insect, yet it is preposterous to suppose that no grasshopper disputed with the domestic live stock as to which should eat the grass of these Canadian pastures. "Pastures of Puerto Rico and Their Relation to Soil Conservation"[4] also says not a word of the insects that feed on the pasture grasses of Puerto Rico. Admittedly, however, it does not leave out all mention of insects, for concerning the weed "botoncillo" it states: "It is host plant for the beneficial wasp *Larra americana,* which is a parasite on changas or mole crickets." Reassuring as it may seem to have one's pet parasite introduction project[5] thus signalized for mention, it raises the disturbing suspicion that this may be only the doubtful reward of undue propaganda.

Dr. Herbert Osborn has written an entire book about "Meadow and Pasture Insects" of North America. In the tropics, as elsewhere, the effect of insect life in grasslands may be conspicuous, and is especially obvious when an attempt is made to replace native grasses. The Agricultural Experiment Station at Mayaguez has reported[6] the susceptibility of Java grass, *Polytrias amaura,* to the attack of the chinch bug, but nevertheless it was planted at one of the naval bases in a region of Puerto Rico where chinch bugs are notably scarce on all native grasses. Despite a rainfall normally excessive for chinch bugs, the favorable factor of a very susceptible grass enabled them to become so abundant as to kill the grass in large patches, and render the entire lawn so yellow as to contrast unfavorably with the standardized dirty green camouflage of the buildings. At an army post in

[1] *Ecological Monographs,* 7 (1): 1–90, January, 1937.
[2] See Bibliography, *Bull. Chicago Acad. Sci.,* 6 (4): 63–124, August, 1941.
[3] Tech. Bull. No. 44, Dominion Experiment Station, Swift Current, Saskatchewan, September, 1942.
[4] Misc. Pub. No. 513, U. S. Department of Agriculture, May, 1943.
[5] *Jour. Econ. Ent.,* 34 (1): 53–6, April, 1941.
[6] Report Puerto Rico Agricultural Station, 1936.

[5] W. M. Stanley and Thomas F. Anderson, *Jour. Biol. Chem.,* 139: 325, 1941.
[6] T. E. Rawlins, SCIENCE, 96: 425, 1942.
[7] T. E. Rawlins and Nedra M. Utech. Unpublished results.
[8] J. D. Bernal and I. Fankuchen, *Jour. Gen. Physiol.,* 25: 111, 1941.
[9] J. T. Edsall, *Advances in Colloid Science,* 1: 269, 1942.