

chains; this distance may be as small as 9.3 Å. (*Bombyx mori*) or as large as 15.7 Å. (*Nephila senegalensis*). In fibroins with the larger inter-sheet separations amino-acid residues with long side-chains must occur in the crystalline regions. In view of the importance of this idea, which has always been virtually rejected before in theories of fibroin structure, further details of the relevant chemistry would be welcomed.

The cross- $\beta$  configuration, so extensively studied in the keratin-myelin-elastin-fibroin group of fibrous proteins, has always been something of a puzzle because of the difficulty of obtaining a good X-ray diffraction diagram. That a solution of the problem should now be given in terms of a structure closely allied to a fibroin rather than to keratin is one of those oddities which sometimes arise in fibre structure research. K. D. Parker and K. M. Rudall (Leeds) have found, in fact, a cross- $\beta$  fibroin in the egg-stalks of the lacewing fly; it gives a remarkably good X-ray diffraction pattern the interpretation of which leaves no doubt that the fibroin chain-molecules are arranged in long folds transverse to the fibre-axis. From this folded configuration the chains can be brought into the parallel- $\beta$  state by stretching the material to about six times its initial length. This change is regarded as a true intramolecular transformation like the  $\alpha$ - $\beta$  transformation in keratin, but differs from the latter in that so far no success has followed attempts to reverse the change.

Heavy-metal staining techniques are of great importance in electron microscopy, and are now being successfully employed in studies of the microfibrillar texture of keratin fibres. Work is going on in various centres to correlate such electron microscope observations with the older X-ray results that mercury, for example, can modify the intensities of the equatorial 'reflexions' at approximately 80 Å., 45 Å. and 27 Å. in keratin. H. J. Woods (Leeds) reported that staining with mercuric acetate also affects the wide-angle diffraction pattern, when corrections are made for increased absorption due to the metal. In an attempt to account for the small-angle 'reflexions' in terms of a model of uniform microfibrils it is found that conventional Fourier transform methods for obtaining the radial distribution of interfibrillar vectors are inapplicable, and the direct method of calculating the intensity from an assumed radial distribution often results in a negative intensity. In the discussion it was suggested that there might be a failure of the conventional theory for systems so nearly close-packed as those considered, but it now seems more likely that the difficulty is due to the fact that for such systems the radial distribution must be so nearly determined by geometry that the use of an arbitrary distribution may well be physically unsound. J. Sikorski emphasized that the electron microscope results so far tell us only about the details in para-cortical cells; the size and packing of the microfibrils in the ortho-cortex may well be different. H. J. Woods

## THE SMITHSONIAN INSTITUTION

### REPORT FOR 1957-58

THE report of the Smithsonian Institution for the year ended June 30, 1958\*, covers the 112th year of the Institution and includes the report of the Secretary and the financial report of the Executive Committee of the Board of Regents, together with reports of branches of the Institution and on the library and publications. The Institution has now nearly 51 million catalogued objects in its collections, and visitors to all its branches totalled more than 10.36 million. Field work during the year included the excavation of the Welcome Mound along the Ohio River in West Virginia; continued field investigations of the bird-life of the Isthmus of Panama, and the mammal survey of Panama; a long-range programme designed to solve the stratigraphic sequence in the Glass Mountains; and extensive palaeontological work in Oklahoma, Texas, New Mexico and Colorado.

Systematic researches by the staff of the Bureau of American Ethnology included Eskimo and arctic studies, field-work in South Carolina, among the New York Seneca and in Florida, and excavations at Russell Cave, Alabama. The director of the Bureau continued also as director of the River Basin Surveys, which continued its programme for salvage archaeology in areas to be flooded or otherwise destroyed

\* Smithsonian Institution. Report of the Secretary and Financial Report of the Executive Committee of the Board of Regents for the year ended June 30, 1958. Pp. x+232+14 plates. (Washington, D.C.: Government Printing Office, 1958.)

by the construction of large dams. By June 30, 1958, 254 surveys and excavations had been made in twenty-nine States and 4,889 archaeological sites located, of which 997 had been recommended for excavation or limited testing; by the end of the year, 388 sites in fifty-two reservoir basins in nineteen States had been partly or extensively dug.

The Smithsonian Astrophysical Observatory continued to work along the four principal lines of solar astrophysics, meteors, the satellite tracking programme and studies of the upper atmosphere, in which methods based on celestial mechanics were developed for inferring the density of the upper atmosphere from the motions of artificial Earth satellites, and a theoretical study of the nature and thickness of the lunar dust layer was completed. Its Division of Radiation and Organisms continued studies on photomechanisms in plants, with special emphasis on growth responses controlled by low levels of red and blue radiant energy. Studies of the interaction of gibberellin, kinetin and cobalt with the photo-process indicate that there is no direct interaction between red irradiance and the added substances, although all these materials modify the final growth response. Studies were continued on the effects of radiant energy on the biosynthesis of protochlorophyll in leaves of higher plants grown in the dark, and in a study of biochemical changes involved in the development and maturation of the chloroplast

of higher plants, some progress was made in isolating intact proplastids from leaves grown in the dark.

Good progress is reported in locating a site for a new building for the National Air Museum, to which 193 specimens in 52 accessions were added during the year. The National Zoological Park, to which 1,411 animals were added during the year, now totals 2,316 individual specimens, and visitors exceeded 4 million, while those to the Canal Zone Biological Area totalled 570, of whom forty-three were scientists, students or observers using the station for scientific work, particularly in wild-life

observation, plant and insect studies and photography. The International Exchange Service handled 1,094,798 packages, including 63 full and 43 partial sets of United States official publications in exchange for official publications sent by foreign Governments for deposit in the Library of Congress. The Library received 53,274 publications during the year, and arranged 128 new exchanges. Its holding at the end of the year totalled 974,893, including 586,722 in the Smithsonian Deposit at the Library of Congress. The report includes a list of the 81 new Smithsonian publications issued during the year.

## EFFECT OF NITROUS ACID ON TOBACCO MOSAIC VIRUS: MUTATION OR SELECTION?

By F. C. BAWDEN, F.R.S.

Rothamsted Experimental Station, Harpenden, Herts

GIERER and Mundry<sup>1,2</sup> claim that treating preparations of tobacco mosaic virus or of its nucleic acid with nitrous acid *in vitro* causes mutations. Indeed, they state that their "experiments show that replacement of one single NH<sub>2</sub>-group by one OH-group *in vitro* can change the genetic character of the whole TMV-RNA molecule"<sup>2</sup>. The genetical implications of this statement are so great that, before accepting it, there is more than usual need to ensure that their experiments could have no other interpretation. What their results show is that, when tobacco mosaic virus is treated with nitrous acid, its infectivity, as measured by the numbers of local lesions formed in one tobacco variety, Xanthi, decreases, while the number of necrotic lesions produced in another variety, Java, increases. Xanthi forms necrotic local lesions with all the usual strains of tobacco mosaic virus, whereas Java forms them with only some and not with the type strain.

These results are readily reproducible. Table 1 shows two experiments with the Rothamsted type culture of tobacco mosaic virus; in one, inoculations were made to Xanthi and Java and in the other to *Nicotiana glutinosa* L., which like Xanthi gives necrotic local lesions with the type strain, and to Judy's Pride, a variety of White Burley, which, like Java, does not. The starting preparation, like those used by Gierer and Mundry, produced a few necrotic lesions on Java and Judy's Pride. There is nothing unusual in this, for all bulk preparations of tobacco mosaic virus contain a mixture of strains. However, this being so, it is obviously necessary to consider whether the change in behaviour of the preparations towards the different plants during inactivation by nitrous acid could simply reflect some form of selection from a mixed population of strains. Gierer and Mundry state that this possibility is excluded because the total number of lesions produced on Java increases and not simply the ratio of lesions on Java to those on Xanthi. They therefore conclude that the number of particles able to cause necrotic lesions on Java must have been increased by exposure to nitrite. But must it? Their conclusion rests on the assumption that strains do not interact and that one will always produce its characteristic effects regardless of how much of other strains is present.

Table 1. NUMBERS OF NECROTIC LESIONS PRODUCED BY DIFFERENT *Nicotiana* SPECIES AND VARIETIES WHEN INOCULATED WITH TOBACCO MOSAIC VIRUS TREATED FOR VARIOUS TIMES WITH NITROUS ACID

Time (hr.)	Numbers of necrotic lesions per leaf			
	Exp. 1		Exp. 2	
	Xanthi	Java	<i>N. glutinosa</i>	Judy's Pride
0.0	300	0.5	350	2
0.5	250	9	300	12
1	122	24	210	20
2	98	26	130	28
4	33	12	60	33
20	6	0.5	10	15

Tobacco mosaic virus at 4 mgm./ml. was incubated with 1 M sodium nitrite and 0.25 M acetic acid at pH 4.1 for the times stated, when samples were diluted 1/10 in pH 7 phosphate buffer and used as inocula. Xanthi and *N. glutinosa* give necrotic local lesions with the type strain of tobacco mosaic virus, Java and Judy's Pride do not.

Table 2. NUMBERS OF NECROTIC LESIONS PRODUCED BY DIFFERENT *Nicotiana* VARIETIES AND SPECIES WHEN INOCULATED WITH MIXTURES OF TOMATO AUCUBA AND TOBACCO MOSAIC VIRUSES

Inoculum	Numbers of necrotic lesions per leaf			
	Exp. 1		Exp. 2	
	Xanthi	Java	<i>N. glutinosa</i>	Judy's Pride
Aucuba alone	95	240	66	75
Aucuba in TMV 20 mgm./l.	130	180	128	60
Aucuba in TMV 200 mgm./l.	380	24	350	14
Aucuba in TMV 2 gm./l.	500	2	400	4
TMV 2 gm./l. alone	500	3	450	2

The tomato aucuba mosaic virus was used at 10 mgm./l. With the high concentrations of tobacco mosaic virus (TMV) the lesions on Xanthi and *N. glutinosa* were too many to count accurately.

There is much evidence at variance with this assumption. For example, it has long been known that infection of a plant with one strain of tobacco mosaic virus prevents other strains from producing their characteristic effects<sup>3</sup> and that adding type tobacco mosaic virus to inocula of strains that produce necrotic lesions in Judy's Pride tobacco decreases the number of lesions they produce<sup>4</sup>. One such strain is tomato aucuba mosaic virus, and Table 2 shows how mixing this with various amounts of tobacco mosaic virus can affect the number of necrotic lesions formed on Java and Judy's Pride. Decreasing the amount of tobacco mosaic virus reproduces the phenomenon, which in treatments with nitrite Gierer and Mundry