

the Esthwaite basin. The drop in tree pollen, rise in grass pollen and occurrence of *Plantago lanceolata* suggest that this horizon may represent the beginnings of cultivation in the area.

A useful warning to modern collectors and commentators was implied in the exhibit by Mrs. H. N. Clokie (Department of Botany, University of Oxford) of selected sheets from the Du Bois (1690–1723) and Sherardian (1700–26) herbaria. These showed the confusion and loss of information which can result from illegible labels, or from mounting plants which could not be certainly associated with their labels. The Library of the British Museum (Natural History) displayed a magnificent series of unpublished drawings prepared for Church's "Types of Floral Mechanism" and unpublished text. The view was freely expressed that the publication of these fine additional drawings would be a valuable addition to the book already available.

A full account of the exhibits will appear in due course in the *Proceedings* of the Society. The meeting was attended by about two hundred and eighty members and guests.

J. E. LOUSLEY

<sup>1</sup> Lousley, J. E., *Nature*, 173, 113 (1954).

<sup>2</sup> Lousley, J. E., *Nature*, 171, 335 (1953).

<sup>3</sup> Hultén, E., *Nytt Mag. Bot.*, 3, 67 (1954).

<sup>4</sup> Davies, E., *Watsonia*, 3, 71 (1953).

<sup>5</sup> Heslop-Harrison, J., *Watsonia*, 3, 7 (1953).

<sup>6</sup> Wycherley, P. R., *Watsonia*, 3, 41 (1953).

<sup>7</sup> Green, P. S., *Watsonia*, 3, 122 (1954).

<sup>8</sup> Hambler, D. J., *Nature*, 174, 838 (1954).

<sup>9</sup> Walters, S. M., *Nature*, 173, 1079 (1954).

## HYDRAULIC TRANSPORT OF COAL

TRANSPORT of coal from the mines to the user represents an appreciable proportion of the energy in the fuel. Normally this is done by rail or sea transport; but transportation through pipes as a suspension in water is another possibility. The advantages of hydraulic transport over short distances within the workings of the colliery are apparent—either underground or on the surface, or even as an alternative to normal cage winding. There is, however, the possibility that hydraulic transport of coal could be operated over much longer distances; this has already been accomplished up to five miles, and a hundred-mile pipe-line is planned in the Pittsburgh area. These advantages and many others were described by Dr. Idris Jones, director-general of research, National Coal Board, in an introductory address to a colloquium on "The Hydraulic Transport of Coal" held by the National Coal Board in London during November 5–6, 1952 (pp. vi+75. London: National Coal Board, 1954), which was opened by Sir Charles Ellis.

Although there is in existence much experimental data on the transport of solid material by water streams in open channels and pipes, the numerous factors involved have hindered the formulation of any theory which will give a full understanding of the transport process in pipes. The purpose of the colloquium was to assemble and compare such results as are available and to discuss tentative theories. The first four papers dealt mainly with fundamental theory and the development of dimensionless groups characterizing the flow of suspensions through pipes, with lump sizes up to 4 in. Some of the authors admitted that the present theory is inadequate, and

it is evident that this is only the beginning of research on this subject. The second group of four papers described the development of coal feeders and experimental installations in France and at Markham Colliery.

The discussion on the papers is included in the publication, and the proceedings form a useful basis for further study of a subject which is becoming of increasing practical importance. H. HEYWOOD

## RECENT WORK IN MAYAN ARCHAEOLOGY

OVER a long period of years, the Carnegie Institution, through its Archaeological Department, has produced a most valuable series of publications, most of which deal with the Maya area. The shorter studies in this series have appeared in volumes of *Contributions*, of which that under review is a useful example\*.

No. 52, by Howel Williams, deals with some human and animal footprints first discovered seventy years ago on the outskirts of Managua, Nicaragua, which aroused a great deal of interest when they were found, owing to their supposedly great age. This was based on the considerable depth of four metres at which they were found, and was estimated at 50,000 years or more. Further examples were found at the same horizon in 1941, so it has been possible to study the question afresh. Williams shows that the deposits in and under which they occur are pumices and mud-flows associated with vulcanicity, which must have been accumulated at a great rate, so that their age has been grossly exaggerated. The prints are abundant, and may well have been made by people fleeing from a rain of ash from the volcano Masaya. On the scanty evidence of a sheard of Usulután ware found on the site at a considerably higher level, it is concluded that the footprints are between 3,000 and 5,000 years old. The author holds out little hope of obtaining material for radiocarbon dating, so it is unlikely that this estimate can be improved on.

The second paper, No. 53, by A. V. Kidder and E. M. Shook, describes the partial excavation of a complex temple mound containing at least two important burials at the Maya site of Kaminaljuyú, near Guatemala City. The authors, with J. D. Jennings, have already published an important work on Kaminaljuyú; but it is a very large site and a great deal remains to be done. This was largely a rescue dig, necessitated by the destruction of part of the mound by brick-making activities. The mound proved to belong to the Miraflores phase of the Pre-Classic or Middle Culture Period, dating in all probability from the first part of the first millennium B.C.; the authors had suspected that this might be so, but had been loth, in the absence of positive proof, to ascribe so large and complex a structure to this early period. The importance of the work lies mainly in the recognition of this fact, which may make it necessary to postulate the emergence of 'Classic' social structures, for example, a ruling class, in pre-Classic times, and perhaps to revise our chronological nomenclature accordingly.

Something is known of the archaeological record of the Maya in Northern Yucatan from the Formative

\* Contributions to American Anthropology and History. Vol. 11, Nos. 52–56. (Publication 596.) Pp. vi+236. (Washington, D.C.: Carnegie Institution of Washington, 1954.) 6.75 dollars, paper; 7.50 dollars, cloth.

Period, before, say, the fourth century A.D., down to the fall of the city of Mayapan about a century before the Spanish conquest; but after that there is a gap which is difficult to explain, just when traditions begin to throw some light on Maya history. In No. 54, R. L. Roys studies the Spanish Colonial sites, particularly the churches and convents, in this area and their relations with Maya ruins, in the light of his intimate knowledge of the country and the documentary sources. He concludes, not only that many Colonial towns and villages were on pre-Conquest sites, but also that the churches and plazas generally occupy the old ceremonial centres. This fact, and the destruction of the old buildings to provide materials for the new, are largely responsible for the gap in the archaeological record, and it should now be possible to fill it by exploring suitable post-Conquest sites.

In No. 55, G. Strömsvik describes three superimposed ball-courts at the famous Classic Maya site of Copan, Honduras, together with comparable examples

elsewhere. The courts are structures enclosed by lateral walls for playing a team game with a rubber ball, which in one form or another was widespread in middle America in ancient times, and which still survives on flat courts in remote parts of Mexico. It is possible that the first court at Copan, perhaps dating from the fifth century A.D., is the oldest yet discovered, and the latest may date from late in the eighth century. The latter is remarkable for the presence of three stone macaw heads tenoned into each side of the lateral structures; these may be related to the stone rings which formed a kind of goal in later courts. A feature of the report is a reconstruction drawing of the latest court and its surroundings by Miss Tatiana Proskouriakoff.

No. 56, by R. E. Smith, is a short paper describing pottery, believed to be of late Classic date, from a rubbish pit in Alta Verapaz in Guatemala. It is rather a specialized subject, and its importance lies in the fact that the archaeology of Alta Verapaz is very little known. G. H. S. BUSHNELL

## EFFECT OF STREPTOMYCIN ON VARIOUS ENZYMES RESPONSIBLE FOR SYNTHESIS AND DEGRADATIONS OF HIGHER SACCHARIDES

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PREVIOUS workers have shown streptomycin to affect certain enzyme systems, its inhibition of the oxalacetate-pyruvate condensation<sup>1</sup> being particularly important. However, little has been reported of its influence on enzymes responsible for the synthesis and degradation of oligo- and polysaccharides, and this formed the subject of the investigation now described. It was considered that streptomycin might exert part of its powerful antibiotic action against mycobacteria by blocking some of the enzyme systems which build up their complex polysaccharide molecules. Such a hypothesis is particularly attractive in the case of *Mycobacterium tuberculosis*, since certain of the specific polysaccharides of this organism and the antibiotic show structural similarities, inasmuch as they are both glycosides with furanose and glucosamine components (D-arabofuranose with D-glucosamine<sup>2</sup> and streptofuranose with N-methyl-L-glucosamine, respectively). Furthermore, since streptomycin is mainly of a carbohydrate nature, it was felt that it might serve as either a donor or a receptor in suitable transglycosylation reactions<sup>3</sup> and give rise to modified streptomycins; if this happened, it could account for the relative ease with which mycobacteria can adapt themselves to streptomycin.

In order to test these theories, each enzyme solution was incubated with the appropriate substrate, in the presence and absence of streptomycin sulphate (0-15 per cent), the two digests being adjusted to the same pH to counteract the acidity of the antibiotic salt. At intervals, the digests were analysed for sugars by paper chromatography using (a) the organic phase of a butanol (40 per cent)-ethanol (10 per cent)-water (49 per cent)-ammonia (1 per cent) mixture as the solvent, with aniline hydrogen phthalate<sup>4</sup> and naphtharesoreinol<sup>5</sup> detector sprays, or (b) the benzylamine method<sup>6</sup>, with ninhydrin as the detector. In addition, each sample was examined in 0.2 N acetate buffer (pH 5.0) on four identical

ionophoretograms (600 V., 4 hr.), which were developed, severally, with aniline hydrogen phthalate<sup>47</sup> naphtharesoreinol<sup>5</sup>, a modified Elson-Morgan reagent, and alkaline diacetyl/ $\alpha$ -naphthol<sup>7</sup>.

Although no evidence was obtained with the enzymes studied of a streptomycinase, or of a transglycosylation giving rise to a compound analogous to the naturally occurring mannosyl streptomycin, several interesting effects were observed, as follows:

*Invertases and transfructosylases*<sup>8</sup>. Commercial yeast 'invertase' (British Drug Houses, Ltd.), acting on sucrose, gave fructose, glucose, di- and tri-saccharides. In the presence of streptomycin sulphate (15 per cent), the reaction was retarded, particularly as regards the formation of the higher saccharides. With the 'invertase' of *Aspergillus niger* (strain 152<sup>9</sup>), used as a cell-free extract from a culture grown on sucrose, the effect of streptomycin sulphate was even more apparent. Whereas the enzyme normally converts sucrose into glucose, fructose and higher saccharides, the presence of streptomycin sulphate in concentrations of 0.01 per cent and higher caused a marked inhibition of fructose formation and prolonged the life of the higher saccharides. A possible explanation of these phenomena is that invertase- and transfructosylase-activities are not always exhibited by a single enzyme, as is widely believed (cf. ref. 8), but that there may be two distinct enzymes, one of which is more sensitive to streptomycin than the other; further work to test this hypothesis is envisaged.

*Nigeran synthesis*. The addition of streptomycin sulphate (10 per cent) to the sucrose (10 per cent)-mineral medium used to culture *Aspergillus niger* (strain 152), and also a related strain, caused marked increases (ten- and three-fold, respectively) in the percentages of nigeran<sup>10</sup> in the dried mycelia. Smaller concentrations of streptomycin sulphate had correspondingly smaller effects.

*Panose synthesis*. A cell-free extract of *Aspergillus niger* (strain 152) produced, *inter alia*, glucose, iso-