clude my talk by a reference to the strides which have been taken in new material and machines recently. Here the developments are tangible. In the last five to seven years we have seen a number of new pipes made of p.v.c. plastics, pitch and bituminous fibre, and so on. Early hopes that these might drastically reduce prices of finished work have not been realised, but they have helped to stabilise. Prices for drainage work have not risen very much in recent years.

The new pipes have many advantages mainly on account of their light weight and ease of handling and laying; additionally they are useful in difficult ground conditions such as running sand and peat, because they are made in long lengths of between 20 ft. and 660 ft.; they are as little as 1/30th of the weight of clay tiles.

Some of these pipes are:

(i) 2 in. and 4 in. " Lamflex " of p.v.c.; 660 ft. of 2 in. weighs 84 lb., and can be laid by a modified mole plough and D7 tractor.

(ii) 2 in. " Carag " of polythene in 20 ft. lengths—less than 4 lb. weight per length; also in 3½ in. size. Can be laid like tile.

(iii) 2 in. " Landcoil " of polythene in 660 ft. lengths weighing 1½ cwt. per coil. Needs special machinery to lay it. Also available in 2¼ in. size.

In considering design of schemes with these pipes, reference should be made to the *Notes and Codes of Practice* issued by the Ministry of Agriculture Land Drainage Division,[20] which lists permissible lengths of laterals, methods of laying, materials for gravel envelopes and so on. In my opinion the days of the clay tile are numbered.

In the sphere of mechanisation the development of such new machines as the latest Allen heavy Drainer costing £6,000 reaching a speed of 40 ft./min. (half a mile an hour) with automatic placing and laying drains down to 54 in. Such machines are specialist contractors' tools, and when used with hopper feeding for gravel backfill and envelopes, new light pipes and trained men, costs will be kept level for some time to come.

In the lighter machines for small schemes and for maintenance such implements as the " Ditch Witch ", " Trench Devil " and less exotic-named Davis T66, cutting about 10 ft./min. are most economic. The great advantage of these machines is their ability to cut narrow trenches for the new narrower pipes and so show considerable savings on labour and more particularly when gravel backfill is used, trenches of 3 in. to 4 in. give substantial economies.

The introduction of the McConnel-Thornton-Garnett pipe feeding mole-plough may revolutionise under-drainage of new and established sports fields in the future, when the principles can be properly evaluated and ancillary gravel feeding equipment can be brought into use.

Reference to Textbooks and Papers referred to in the Text:

The second and concluding part of a talk given to the Architectural Association for Advanced Studies in Environment, May, 1968.

10 " Relation between Soil and Water, " ed. T. J. Marshall, *Technical Communication No.* 50, Commonwealth Bureau of Soils.

11 *Drainage Engineering*, ed. J. N. Luthin—American Society of Agronomy.

12 *British Standard Codes of Practice Nos.* 301 and 303.

13 " The Design of Urban Sewer Systems, " Road Research Technical Paper No. 55, H.M.S.O.

14 " Monograph of Discharge Curves for Drain Tile ", Ministry of Agriculture, Fisheries and Food.

15 *Principles of Underdrainage Design in the Belorussian SSR*, pub. American Natural Science Foundation.

16 *Good Soil*, S. Graham Brade-Birks, Hodder & Stoughton.

17 " Problems of Assessing Soil Structure ", E. Crompton, Kings College, Newcastle on Tyne: paper read by British Grassland Society, Dec. 1960.

18 " Recent Developments in the Techniques of Land Drainage ", Paper by R. A. Walpole to 7th Askham Bryan Horticultural Technical Conference, E.F.P.P.

19 *An Outline of Field Drainage with special reference to the Drainage of Sports Fields*, A. L. Turner, pub. by National Association of Grounds men, 1960.

20 " Ministry of Agriculture—Technical Paper No. 209 " and " Notes for the guidance of applicants for grants for Field Drainage, " etc.

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