especially in the riverine part of the estuary, are modified by seasonal changes in the river flow, and this factor can also be reproduced, given a knowledge of the probable magnitude and sequence of floods and dry periods. Where the estuary is exposed to some prevailing wind, the action of this can also be reproduced by means of fans adjusted so as to produce surface waves of the required height.

One factor which cannot be reproduced is the effect of violent gales, the incidence of which, both as regards time and direction, is casual. It is true that over a long period, where there is no prevailing gale direction, the effects of such extraneous forces may be expected partially to counteract each other, but on the other hand one such gale may produce changes in an exposed estuary greater than would occur in months or even years of normal ebb and flow.

For this reason, close agreement between model and estuary over a definite period of years is scarcely to be anticipated. Close agreement can only be expected where the estuary is comparatively sheltered and where the effect of the ebb and flow currents is all-important. For this reason, a model is likely to be more successful of an estuary in which the physical features are such as to give rise to well-defined currents, and in which the tidal range is large so that the strength of these currents is also large. From this point of view the upper Severn estuary, with its 40 ft. tidal range and current velocities approximating 10 knots at places, is an almost ideal subject for model investigation.

Another difficulty in attempting to reproduce all the changes in an estuary over a long period of time is that of reproducing coastal erosion. In many cases this is comparatively small in Nature, but where it is large the difficulties of finding a material which will erode at approximately the correct rate are great. Where this is necessary, it can only be done by extended experiment. In spite of the difficulty, however, experiments now in progress on a model of the Rangoon estuary (by Sir Alexander Gibb at University College, London), show that it is possible to reproduce this effect. This model, in which the effects of coastal erosion and of the monsoon gales have been incorporated, represents probably the most remarkable investigation of this type yet attempted.

Generally speaking, the great usefulness of an estuary or river model lies in its power to indicate the probable effect of artificial changes such as may be produced by the introduction of a barrage; or training walls; or bridge piers. Such changes affect the tides and the set and velocity of the currents to an extent and in a manner which is reproduced with close accuracy in a model. In so much as an increased velocity causes scour, and a reduced velocity causes deposition, if the bed material is moved the movement caused by the change will be in the same direction and of the same general kind as in Nature, and experience shows that in favourable circumstances good general agreement, both quantitative and qualitative, can be obtained.

Some estuaries, owing to their physical characteristics, are not suitable subjects for model investigation, but at the worst such an investigation gives information as to the changes in the velocities and directions of the currents, from which valuable deductions as to the probable effects on the bed may be made.

South African Plants Poisonous to Stock

THE subject of plants poisonous to cattle is of perennial interest to pastoralists, which is receiving in South Africa the scientific attention it needs. The Veterinary Services and Animal Industry Branch of the Department of Agriculture of the Union of South Africa now has a team of workers (Onderstepoort Veterinary Research Station) consisting of Drs. Steyn and Quin, veterinary research officers, Dr. Claude Rimington, chemist working as a research fellow under the Empire Marketing Board, and Dr. A. C. Leeman, botanist attached to the Division of Plant Industry, Pretoria. The first two numbers of the *Onderstepoort Journal*, which is to be issued quarterly in continuation of the annual reports of the Station, contain several interesting papers on the subject.

In a series of six papers in the first issue, Dr. Steyn deals on broad lines with poisonous plants. It is shown that it is possible to develop in animals a considerable degree of tolerance to certain poisonous plants by feeding them with small, but increasing, quantities, whilst with other plants continued ingestion of small quantities may even cause sensitisation or produce cumulative effects. An interesting side-issue is the proposal to use sodium chlorate as a weed-killer for the rag-worts (*Senecio* spp.), which are responsible for poisoning stock, both in New Zealand and South Africa. Before adopting it, its toxicity to stock has been carefully tested and found so low that it is regarded as a safe means of destroying these weeds.

It is still uncertain whether the disease known as 'lathyrism', common in certain parts of India, is due to use of *Lathyrus sativus* peas as a foodstuff, and for that reason a proposal to use *L. sativus* hay as a feeding-stuff in South Africa has been investigated. The hay proved innocuous to rabbits, sheep and cattle even when fed in comparatively large amounts, but was poisonous to horses. Great care was taken to make sure that the hay was entirely derived from *Lathyrus sativus*, and these observations support the view that this plant is the cause of 'lathyrism', and that horses are particularly susceptible to its action.

These studies are continued in the second number of the *Journal*, where Drs. Rimington and Steyn produce an interesting study of the poisoning of Angora goats, suspected to be due to *Psilocaulon absimile*. This plant contains malic, tartaric and oxalic acids, the last-mentioned being present to the extent of 8·6 per cent, which may therefore well be the toxic constituent concerned. On this point, however, the authors say they have evidence of the presence of a second toxic substance on which a further communication will be presented in due course. Six papers entitled "Studies on Photosensitisation" by Dr. Quin have arisen from an attempt to ascertain the cause of 'geeldikkop', a disease of small-stock, characterised by photosensitisation and by a generalised icterus. The disease has been generally associated with ingestion of *Tribulus* spp., but it is pointed out that there are well-authenticated cases in which *Tribulus* cannot be the cause. In view of the occurrence of photosensitisation in 'geeldikkop', a number of fluorescent substances such as eosin, erythrosin, acriflavin and quinine were administered to sheep, but though these all caused photosensitisation, in no instance was icterus produced.

The association of *Tribulus* with this disease has naturally led to a chemical examination of plants of this genus. Already in 1928 Dr. Quin had found that administration of the expressed juice of *Tribulus* to sheep caused death, the chief symptoms being discoloration of the conjunctivæ, the blood-vessels having a chocolate-brown colour. Examination of the blood indicated the presence of an abnormal pigment suspected to be methæmoglobin. These observations have been confirmed, and Drs. Rimington and Quin now show that the lethal factor is potassium nitrite, which is only present in traces in the plant, but is produced when the ground plant is placed in water by the action of an oxidation-reduction enzyme system, similar to that present in the potato, on nitrates which may occur in considerable quantity in the plant. These interesting observations, however, leave the association of *Tribulus* with 'geeldikkop' unexplained since, as Dr. Quin points out in a subsequent paper, no fresh or dried *Tribulus* material dispatched to the Onderstepoort laboratory, or cultivated there, has produced a case of true 'geeldikkop' on administration to sheep, although several species of *Tribulus* can definitely be held responsible for outbreaks of the disease in the Karroo areas of Cape Province (see also NATURE, 132, 178, July 29, 1933).

Two species of *Hypericum*, a genus associated with the production of photosensitisation in animals in Europe, have also been examined and found to produce this effect, but unaccompanied by icterus. *Lopholæna coriifolia*, a plant suspected as a possible cause of one outbreak of 'geeldikkop', was found to contain an active substance producing marked fatty changes in the liver, but in no way characteristic of the conditions found in 'geeldikkop'. Two species of *Lippia*, however, did produce both icterus and photosensitisation, but the symptoms were much less severe than those seen in true 'geeldikkop'. Although a final explanation of the cause of this mysterious disease is still to be sought, it is clear that progress is being made, and incidentally a number of interesting observations on plant chemistry and on the effects of minor plant constituents on animals are being accumulated.

Obituary

PROF. W. M. DAVIS

EVERY active worker in geology, in geography and in oceanography will feel that the death on February 5 of William Morris Davis, at the age of eighty-four years, is the passing away of a historical figure in science. His life when written will be the story of the development of geomorphology and of the creation of an American school of international prestige. His whole career, more than sixty years of active scientific work, exhibits the regular series of interests of many great investigators, detailed studies in a relatively limited scientific field, next broader applications supported by intense, varied and enthusiastic studies to test and support the same—and finally the close of life devoted to a single line of investigation, often the ploughing of a lonely furrow.

Davis's first field was the southern part of New England, including New Jersey, and his publications extend to every type of its topography. About 1880 he concentrated on the Hudson and Connecticut valleys. These lie in a region of tilted blocks produced by faulting, the initial fault scarps subjected to extensive erosion. As Davis showed, the cliffing may be completely altered and these cliffs were termed *fault-line scarps*. He was fascinated by these studies of erosion, and he summarised his many publications in "The Rivers and Valleys of Pennsylvania" and "The Rivers of Northern New Jersey". He pictured the work of unchecked erosion on the land, by weathering and by water, in all its stages, finally culminating in a reduction of sea-level, the *base-level* "towards which the land surface constantly approaches . . . but which it can never reach". Here he encountered the established views in respect to marine abrasion, and he characteristically set to work on investigations in Europe, Asia and South Africa to establish the validity of his views. He also studied glacial (recent and Permian) erosion, faulting and shorelines, with a certain disregard of local researches. His work on shoreline topography, the continental slopes and marine shelves, bristles with original ideas, but the soundings on which he was depending were occasionally woefully inaccurate, though I cannot recall that these were such as to invalidate his conclusions as to embayed shorelines. It will be