in which much damage had been, or was likely to be, caused to national monuments by reckless interference. To meet this evil, he suggested the establishment of an advisory committee, composed of men eminent in archæology and public life, with representatives of the leading archæological societies, the British Museum, nominees of the Archbishops of Canterbury and York, and of the Ecclesiastical Commissioners.

It should be the duty of the committee, when satisfied that any monument of national importance was in danger, to recommend to the First Commissioner of Works that the custody of it should be assumed by the nation. On receipt of this report, the First Commissioner, if he thought fit, should move his Majesty to declare by an Order of Council that the monument was one of national importance, and was accordingly transferred to the custody of the First Commissioner. The scheme should not, he suggested, apply to dwelling houses in actual occupation, but in the case of important ecclesiastical buildings now in use he proposed that no scheme of restoration should be carried out until the plans had been passed by the advisory committee. Until the question has been more fully discussed, it would be premature to pass an opinion upon it. But, on the whole, it seems to offer a suitable remedy for a very important and growing evil.

NOTES ON MUSEUMS AND MENAGERIES.

IN *The Field* of December 9, 1911, there is an illustrated account of the new buildings recently added by the Hon. Walter Rothschild to his zoological museum at Tring, these additions considerably more than doubling the size of the original structure. As extended, the building forms three sides of a square, of which, when viewed from the front, the central transverse portion and the right wing are new. The exhibition galleries are throughout lighted by windows placed high up in the walls, so that comparatively little direct sunlight falls on the cases, this being screened, when necessary, by scarlet blinds, which are claimed by the owner to prevent all the ill-effects of actinism. The new exhibition galleries are fitted along each outer wall with a continuous series of glass and steel cases, 10 feet in height, and constructed on a modification of the principle adopted in the zoological museum at Dresden, these being stated to be absolutely dust-proof. A similar but wider series of cases, divided by a longitudinal partition of wood, occupies the middle line of each of the new galleries. The new buildings include also a library, containing 30,000 volumes, forming about 6000 separate works, workrooms, studies, &c.

With characteristic promptitude and energy, Mr. Rothschild has already arranged his specimens (which were previously crowded together) in the new cases, so that naturalists and the general public are able to appreciate the vast extent and excellent mounting of this really marvellous collection. The mounting of the larger mammals, as well as of many of the birds, has been in recent years mainly executed by Rowland Ward, Ltd. For a notice of some of the specimens in the exhibition galleries our readers may be referred to the article already cited.

The La Plata Museum forms the subject of an article by Dr. E. H. Ducloux, the vice-director, in the *Revue générale des Sciences* of November 15. That institution, which the writer considers to be the most important of its kind in South America, is the work of a single individual, Dr. H. P. Moreno; and to write the history of the former is practically the same as to write a biography of the latter, who was the first director. The museum was established by the Provincial Government in 1889 on the base of an anthropological and archæological museum founded in 1877. In its foundation Dr. Moreno had to wage an uphill fight against indifference, and sometimes hostility, in high quarters; but he eventually succeeded in getting the present palatial building erected, and brought together the wonderful collection of Argentine and Patagonian extinct vertebrates which has rendered the institution deservedly famous throughout the scientific world. It was the aim and intention of its founder that the functions of the museum should include not only science, but to a certain extent art; and, as at present constituted, its organisation embraces geography, geology, mineralogy, palæontology, botany, zoology and anatomy, anthropology (including ethnography and linguistics), and chemistry and pharmacy, while a special annexe is devoted to a school of design.

The statute of September 25, 1905, which organised the National University of La Plata—of which, according to the author, the already existing municipal scientific institutions ought to form the foundation—will, it is hoped, open to the museum a wider horizon, and remove it from the verge of penury which, under any other direction, would eventually bring about its ruin. The article contains several illustrations, one of which shows part of the wonderful series of the giant armadillos, or glyptodonts, of the Pampean epoch.

In the November number of *The Zoologist* Captain Stanley Flower concludes his notes on zoological institutions in various parts of Europe recently visited by himself. Dealing in this contribution with Stuttgart and Vienna, he remarks that, among the forty-eight institutions inspected, "the Tiergarten at Doggenburg, near Stuttgart, would be the most profitable to visit. The site is small, the collection is small, and the animals are of no great value, but the arrangement is such that everything is exhibited to its best advantage. The lover of animals who visits Doggenburg will carry away with him the impression that he has seen but few species, but these all carefully provided for and happy; the schoolchild will have seen the principal types of the vertebrate fauna of Europe, and enough exotic ones to excite his further interest; the casual visitor will not know exactly what he has or has not seen, but will feel satisfied that he has had his money's worth.'"

CARBOHYDRATE FORMATION IN PLANT FOLIAGE.

A VALUABLE and interesting contribution to the study of the formation of carbohydrates in the foliage leaf is contained in a paper, by Mr. John Parkin, published in *The Biochemical Journal* (vol. vi., part i.). In order to simplify the case as much as possible and to reduce the conflicting factors to a minimum, the snowdrop (*Galanthus nivalis*, L.) was chosen as the plant to be investigated, as in a previous research the author had shown that in no case is starch or inulin to be detected in the mesophyll of the leaf. It was therefore probable that maltose would be absent in the leaf also, and the research would be thus narrowed down to studying the relationship between cane sugar, dextrose, and lævulose under different conditions. The object aimed at in the beginning was to test Brown and Morris's view, enunciated in 1893, that cane sugar is the first product of carbon-assimilation in plants.

It was found, actually, that maltose is always absent from the snowdrop leaf, so that it appears probable that maltose, when present in foliage leaves, is a hydrolysis product of starch. The quantity of total sugars in the snowdrop leaf is considerable, being from 20–30 per cent. of the dry weight in leaves actively assimilating. The amount of sugar increases from above downwards in a single leaf, and, at the same time, the ratio of the cane sugar to the hexoses (dextrose and lævulose) diminishes. The *proportion* of cane sugar to the hexoses decreases as the season advances, that is to say, in the early part of the season there is more cane sugar in proportion to reducing sugar than later, the comparison being made between leaves gathered about the same period of the day. During any single day the *percentage* of hexose sugars in the leaf remains fairly constant, no matter at what hour out of the twenty-four the leaves may be examined. That of the cane sugar, however, fluctuates greatly, increasing during the day and decreasing during the night. Further, leaves detached and insolated contain decidedly more cane sugar than their controls, but the quantity of hexose sugar remains nearly the same. The lævulose, as a rule, is in excess of the dextrose, irrespective of the time of day or the period of the spring the leaves are picked for analysis.

In discussing these results, the author inclines to the view that cane sugar is, as suggested by Brown and Morris, the first sugar formed in the leaf. But they are not entirely incompatible with the idea that dextrose is the

first recognisable sugar, which recently obtained strong support from the discovery in 1907, by Strakosch, that dextrose is the only sugar present in the actual mesophyll of the leaf of the sugar beet, and that cane sugar, which is almost the only sugar in the root, first makes its appearance, together with lævulose, in the lateral veins of the lamina, and increases in amount in the midrib and petiole.

From an interesting discussion of the function of cane sugar in plants, with which the paper closes, the following may be quoted:—"Its special physical and chemical properties are of interest. It is very soluble and readily crystallises—more so than the other sugars occurring in plants. It is very easily hydrolysed by acids and by invertase. It shares with trehalose, alone among the disaccharides, in having no reducing properties. Maltose, lactose, &c., do reduce, and so may be said to have the aldehyde group in their molecule functional.

"Sucrose may thus have been selected in the higher plants as the chief circulating sugar, partly on account of its non-reducing properties and soluble (mobile) nature, and partly on account of the ease with which it can be hydrolysed into its two components, glucose (dextrose) and fructose (lævulose). These hexoses may, as a rule, play distinct parts in metabolism—the glucose more readily lending itself to the respiratory needs and the fructose to constructive work, such as the building up of the plant's framework. It is also within the bounds of probability that cane sugar itself may take a direct part in the formation of cell-walls. Just as it appears able to be condensed to starch without previous inversion, so it may be transformed directly to cellulose in the construction of cell-walls. Fenton's work is interesting in this connection. He has shown that various kinds of cellulose respond markedly to a special ketose test, and thus concludes that this substance may contain one or more groups identical with that present in fructose."

THE DEMOCRATISATION OF MATHEMATICAL EDUCATION.[1]

THE work of the Mathematical Association, in connection with its activity in promoting the reform of mathematical teaching in our schools, necessarily involves the expenditure of much time and thought upon the detailed discussion of specific schemes for the improvement of the teaching in special departments of mathematical education. It is, however, well that we should sometimes reflect upon the more general aspects of our work; and perhaps a presidential address affords the most suitable occasion for reducing some such reflections to an explicit form, even though nothing essentially new can be said upon the matter.

In making a few brief remarks upon the general character of the reform movement, I propose to emphasise one or two governing principles which I regard as of fundamental importance in relation to mathematical teaching. If I venture, in the course of my remarks, to make some suggestions on less general matters, the adoption of such suggestions as parts of the policy of the Association would only be possible after much detailed discussion of the manifold points which would have to reach some degree of settlement before the suggestions could be translated into the domain of practice.

The modern tendency which has exhibited itself in our time in greater or less degree in all countries in educational policy in general may be described as the tendency towards the democratisation of education. This term, or some synonymous one, has frequently been used to denote the extension of education to wider classes of the population; but it is not in this quite general sense that I intend here to employ the expression. I mean by it rather the progressive adaptation of educational methods to the *intellectual democracy*; the transformation of the methods of teaching and of the matter of instruction so as to meet the needs of those who are lacking in exceptional capacity, at least in relation to the particular branch of study in question; in other words, the concentration of the attention of the educator, in a much greater degree than formerly, on the work of developing the minds of the average many and not solely of those of the exceptionally gifted few. The progress of democratisation of education, in this sense, has been perhaps more marked in the case of mathematical instruction than in other departments. In our own country the Mathematical Association has been conspicuous as an agent in furthering the democratisation of mathematical education. It is very certain that no such democratisation could be effected without more or less radical changes being made both in the methods of teaching and in the selection of the matter taught. It would be of but little avail that the attention of the teacher should be concentrated in a greater degree than formerly on the average many if the methods of teaching and the material taught remained unreformed.

With a view to the formation of some estimate of the profit and loss due to the changes which have taken place of late years in the teaching of mathematics in our schools, let me briefly glance at some of the differences, both in theory and in practice, which distinguish the older and the newer methods from one another. Any exaggeration of which I may be thought guilty must find its excuse in the fact that I am attempting to indicate only the more salient features in a continuously progressive movement.

In accordance with the older and traditional treatment of mathematical instruction in our schools, geometry was treated in a purely abstract manner, the idea being that Euclid, as a supposed model of purely deductive logic, should be studied entirely with a view to the development of the logical faculty. Any knowledge of space relations which might have been imparted by this study was reduced to a minimum by the excessive insistence on all the details of the syllogistic form, the whole attention of the pupils being engrossed by the effort to commit to memory a long chain of propositions in which the actual geometrical content was exceedingly small. On the other hand, algebra, and to a great extent arithmetic, were taught without any regard to their logical aspects, but mainly as affording discipline in the purely formal manipulation of symbols in accordance with prescribed rules, little or nothing being said as to the origin of such rules. The teaching of mechanics was assimilated, so far as possible, to that of geometry, the true position of the subject as a fundamental part of physical science being almost wholly obscured. That the average boy or girl is not by nature appreciative of formal logic or of the interest and meaning of abstract symbols was thought to be a reason why the subjects so treated should be especially insisted on.

In fact, the notion of mathematical teaching was that it should be in the main medicinal and corrective. Its advantages consisted largely in calling forth the use of faculties which are the rarest in the average boy or girl, and were therefore thought to be in special need of development. It was thought to be by no means wholly a disadvantage that these subjects, so treated, were found hard and repulsive by the majority. It was thought that the hard discipline involved in the attempt to assimilate them developed a kind of mental grit, and involved a certain species of moral training, even when the intellectual results were small. A certain strengthening of faith, to be acquired in the process of hard work spent on subjects of which neither the aim nor the utility was obvious to the pupil, was thought to be highly beneficial.

It is unnecessary for me to enlarge upon the defects of this system, and on the inadequacy of the ideals underlying it. The existence of the Mathematical Association is a warrant of the widespread dissatisfaction with these methods, both in their results and their aims. The system as it existed in our schools was condemned by its failure. It failed to attain even its own narrow ideals, except in the case of a very select few among the pupils. The many rejected the material which was for them wholly indigestible mental food. The system was, in the sense in which I have used the term, undemocratic. The results obtained in the case of the vast majority were deplorable; and it needs indeed a strong faith in the anti-democratic principle to imagine that this failure was compensated by the effect of a hard and bracing training on the few who, by mental constitution, were enabled in some degree to profit by it. Even the chosen few suffered severely from the effects of the narrow conception of education which lay at the base of the methods of instruction; for the

[1] Presidential address delivered to the Mathematical Association on January 10 by Prof. E. W. Hobson, F.R.S.