reaching snow-covered crevassed ice; but, to our surprise, we found that the apparent *névé* field was a slope of ice reaching to the col, or the mountain summit. We naturally devoted much attention to a comparison of the deposits accumulated by marine and land ice. Both lay down glacial beds of very varied characters. We had no difficulty in finding cases of the formation of typical boulder clay by land ice. We also kept in mind the questions of the possibility of the uplift of material through ice, and of the existence of a differential flow in glaciers. To take one case of the former: in the moraine lying on the eastern face of the "Ivory Gate Glacier" we found many fragments of shells which had been lifted above the level of the old sea beaches, whence they had been derived. This supplied us with one clear case of the uplift of material, and the sections round the snout of this glacier left no doubt as to the method by which this is effected. The proof of a differential flow in glaciers is even more conclusive; the evidence of the extent and importance of such movements strikes us as the most impressive fact in the glacial geology of Spitzbergen. Many of the glaciers terminate with precipitous faces; these show that the layers of ice have the false-bedded arrangement that is familiar from photographs of the Greenland glaciers. Study of the sections shows that beds of englacial drift are being uplifted or carried in a direction different from that of the main movement of the ice. As we climbed and sketched the face of the "Booming Glacier" at the head of Advent Vale, we could not but recall Mr. Goodchild's paper on the "Glacial Phenomena of the Eden Valley" (1872); for we could see deposits of the same characters as those he there describes being formed by ice, acting in the way which he there assumes it must have acted.

The raising of beach material is also effected by the stranding of bergs and floes upon the sea shore; but the range of this action is not very great. The Spitzbergen walrus and seal hunters and fishermen agree that ice is never forced on shore more than one hundred yards inland, or to a height of over fifty feet.

Marine glacial deposits occur in many parts of Spitzbergen; but moraines formed in the sea differ from those formed on land—by their shape, by the character of the material, and its arrangement.

It is, perhaps, unnecessary to add that the glaciation of Spitzbergen was solely due to a local glaciation. We found no evidence of any great polar ice cap. Had any such have existed and overridden Spitzbergen from the north, we ought to have seen its traces. On the contrary, along the north coast the ice movement was from south to north. J. W. GREGORY.

THE LAST DAY AND YEAR OF THE CENTURY: REMARKS ON TIME-RECKONING.

THE late Astronomer Royal, Sir George Airy, once received a letter requesting him to settle a dispute, which had arisen in some local debating society, as to which would be the first day of the next century. His reply was: "A very little consideration will suffice to show that the first day of the twentieth century will be January 1, 1901." Simple as the matter seems, the fact that it is occasionally brought into question, shows that there is some little difficulty connected with it. Probably, however, this is in a great measure due to the circumstance that the actual figures indicating the century are changed on January 1, 1900, the day preceding being December 31, 1899. A century is a very definite word for an interval, respecting which there is no possible room for mistake or difference of opinion. But the date of its ending depends upon that of its beginning. Our double system of backward and forward reckoning leads to a good deal of inconvenience. Only the other day I was reading in a high-class scientific periodical (the *Journal* of the Astronomical Society of Wales), that the Athenian expedition under Phocion to succour Byzantium (attacked by Philip of Macedon) took place in B.C. 339, and that that was now exactly 2235 years ago.[1] But it is evident that as there was no year 0, and B.C. 1 immediately preceded A.D. 1, the interval from any date in a B.C. year to the same in an A.D. year is found not by simply adding the respective years, but by afterwards subtracting 1 from this sum. Our reckoning supposes (what we know now was not the case, but as an era the date does equally well) that Christ was born at the end of B.C. 1. At the end of A.D. 1, therefore, one year had elapsed from that event, at the end of A.D. 100, one century, and at the end of 1900, nineteen centuries.

Believing that our Lord was born in the autumn or towards the end of B.C. 5, I once stated that our ordinary reckoning was five, not four, years in error, because the interval from a given date in B.C. 5 to the same in A.D. 1 is five years. But I was properly pulled up for saying so, because our reckoning supposes that Christ was born in B.C. 1, and B.C. 5 is the fourth year before that, so that if we could now revert to the correct year of the Nativity, the present year would be 1900, *i.e. the nineteen hundredth year after the birth of Christ.* At its close nineteen centuries from that event would be completed, and the twentieth century commence with January 1 next year, which would be called 1901. Here is where the apparent difficulty comes in. Some people fancy that the year 1900 means 1900 years after the birth of Christ; but the years are in fact ordinal, not cardinal, numbers, and the century is completed, not at the beginning, but at the end of that year. The mistake is of the same kind as if we should conclude from a man being, for instance, in his sixty-second year that he was sixty-two years old. A recent writer in the *Times* points out that though the same argument applies to the hours of the day, we do in fact use cardinal numbers in this respect; and when we say, for instance, 4 o'clock in the afternoon, we mean that four whole hours have passed since noon, whereas by analogy with the number indicating the year, we might mean the fourth hour. This of course is what the Germans do, in speaking of time between two consecutive hours, *halb vier*, for instance, with them meaning half-past 3, or the fourth hour, half gone. But it would be impossible to designate by half-*past* 4, for instance, half an hour or thirty minutes in the fifth hour or of hour five; and the French idiom equally necessitates counting the portions of an hour from the hour as a cardinal number.

It is clear then that the year, as we call it, is an ordinal number, and that 1900 years from the birth of Christ (reckoning it as we do from the end of B.C. 1) will not be completed until the end of December 31 in that year, the twentieth century beginning with January 1, 1901, that is (to be exact), at the previous midnight, when the day commences by civil reckoning. The writer referred to above, truly says that in speaking of months of the year and days of the week we also use ordinal numbers; but in these, when that method of designating them is used, we actually say so, and call them the first or second, &c., month or day. The year, on the other hand, is always spoken of as a cardinal number; but probably this is on account of its number being large. Had the reckoning from the true or supposed date of the birth of Christ been commenced in the first century, the years would doubtless have been called, like those of the reign of a king or queen, the first, second, &c., or fiftieth, sixtieth, year. In mentioning the hours of a day, the matter becomes somewhat different, because we see them

[1] The expedition really took place late in the summer of B.C. 340, and there may be a misprint here. The article is in reference to a medal struck at Byzantium, representing an occultation which occurred at the time, and is the origin of the present Turkish standard.

marked and hear them struck on a clock. We think therefore of an hour not as an interval of time, but as an instant, which is that of the completion of the hour, 4 o'clock or 4 by the clock, meaning that four complete hours have passed since the beginning of the clock-round. When this is noon, and the hours afternoon hours, all is logical enough. We are obliged to call the beginning of the round the completion of the preceding; because though a clock may mark 0, as clocks used in observatories do, we cannot indicate nothing by a strike. Our ordinary habit, however, becomes illogical when we speak of morning hours and call them a.m. or ante-meridiem; for eight hours, for instance, before noon should mean what we call 4 o'clock in the morning or 4 a.m. To be logical, the morning or a.m. hours should diminish instead of increasing; but the usage cannot well be altered, and it is not likely that ordinary people will ever adopt the astronomer's plan and count the whole day through twenty-four hours, even if astronomers try to conciliate them by dropping their practice of beginning the day at noon. For this there is now much less reason than there was in early days of the science, when it was thought desirable to keep a whole night's observations under one date; for modern astronomers make a considerable number of observations in daylight and during the day hours.

W. T. LYNN.

POPULAR GEOLOGY.[1]

SOME fifteen years ago, if a book had been published under the title of "The Scenery of Switzerland," the reading public might have expected glowing descriptions of the magnificent mountains, the wild waterfalls, the quaint châlets, the dangerous passes and precipices of that wonderful Alpine rampart of Switzerland

> "Which serves it in the office of a wall,
> Or as a moat defensive to a house,
> Against the envy of less happier lands."

And it would have been somewhat startled on opening the book to find the first chapter dealing with the "Geology of Switzerland," and bristling with a supply of technical terms seldom to be found outside a geological text-book. Nevertheless, that is how Sir John Lubbock's new book opens, and the title is accordingly somewhat qualified on the inner fly-leaf, where it reads in full, "The Scenery of Switzerland and the Causes to which it is due."

We have already had the æsthetic aspect of the Alps presented to us by such writers as Symonds, Ruskin, and Leslie Stephen; the mountaineering aspect by such famous climbers as Whymper, Freshfield, and Conway; the scientific aspect by Forbes, Tyndall, Bonney and others; and now Sir John Lubbock seeks to combine the æsthetic and the scientific aspects. It may be said at once that the book supplies to the cultured tourist a want which has been felt more and more for some years. Years during which Dr. Lunn's inexpensive tours have brought a journey to Switzerland within the reach of modest incomes, and when popular lectures on physical and geological subjects have attracted ever-increasing interest. Besides, these are *fin de siècle* days, when the mere sensuous enjoyment of the beauties of Swiss mountains is not enough to gratify the tourist! He wants to surmount their difficulties, either physically by climbing their summits, or mentally by mastering the secrets of their structure—to *come* and *see*—yes, but also to *conquer* the grandeur of the Alps!

The intellectual conquest of the Alps, however, is not yet completed by geology; and this is the very fact which has restrained many of the veteran geologists abroad from attempting a popular book on the subject. Prof. Fraas published in 1892 a useful book called "Scenerie der Alpen," which erred in being too geological for the ordinary tourist. In 1894, the Committee of the International Geological Congress published a special "Livret-Guide" of Switzerland, wherein pedestrian tours are planned and described geologically by the best Swiss authorities on the various areas of the Alps. With these exceptions, Sir John Lubbock entered an open field, and has done so with considerable success.

The book numbers 473 pages, arranged in twenty-five chapters. About two-thirds of it are devoted to the *geological* causes, while one-third discusses the *physical* causes which have moulded the surface features of Switzerland.

It is perhaps rather unfortunate that the book begins with three such difficult chapters as those entitled "The Geology of Switzerland," "Origin of Mountains," and "The Mountains of Switzerland." In the opening pages the reader finds himself perforce initiated into the involved question of the origin of gneiss.

> "The foliation of Gneiss is probably of two kinds: the one due to pressure, crushing, and shearing of an original igneous rock such as Granite, the other to original segregation-structure" (p. 3).

A sentence like this cannot but be a stumbling-block to the ordinary reader. Granite, Serpentine, the Crystalline Schists, and the successive geological periods from Carboniferous to Miocene and Glacial time are briefly dealt with. The second chapter contrasts "Table Mountains" with "Folded Mountains," and demonstrates that the Swiss mountains belong to the latter class, having been "thrown into folds by lateral pressure." Geological terms—such as outcrop, dip, and strike; fold, fault, and fold-fault; anticline, syncline, slickenside, and cleavage are explained; various examples are also given of the dynamo-metamorphic changes induced in rocks. Attention is directed in the third chapter to the fact that the main longitudinal valleys (*e.g.* the Rhone-Rhine valley which cuts through Switzerland in the direction of the main axis, S.W.-N.E.) occupy the troughs of the mountain-folds, whereas the transverse valleys (*e.g.* the Reuss and Ticino in N.W.-S.E. direction) are independent of the folds, being "entirely due to erosion." Denudation of the surface is discussed, and the geological proofs are given of the former presence of an arch of sedimentary strata above the crystalline rocks of the central chain of the Alps. Three well-known geological sections illustrate the text—Schmidt's section from the Rhone valley at Viesch to the Averser valley in the Engadine, Favre's "Mont Blanc" section, and Heim's "Windgälle and St. Gothard" section. A computation "gives 4500 metres or, say, 14,000 feet, which erosion and denudation have stripped from the summits of the mountains!" (p. 66).

There follows a lighter series of six chapters on glaciers, valleys, rivers, and lakes. The physics of ice and ice-movement, and the characteristic features of glaciers are carefully described. Evidences of the "Former Extension of Glaciers" are considered, and abundant examples quoted of the influence which ancient moraines had in diverting the courses of rivers and damming up lakes. The chapter on "Valleys" leads us into some confusion of ideas. A "fault valley" is said to be "comparatively rare" (p. 143). The writer repeats the principle mentioned above, that cross-valleys are valleys of erosion, while longitudinal valleys are of geotectonic origin. But he then asks himself the question, "Why should the rivers, after running for a certain distance in the direction of the main axis, so often break away into cross valleys?" (p. 148). "Three possible explanations," suggested by Prof. Bonney, are given, and then the following passage occurs:—

> "Under these circumstances I have ventured to make the following suggestion. If the elevation of the Swiss mountains

[1] "The Scenery of Switzerland, and the Causes to which it is due." By the Right Hon. Sir John Lubbock, Bart., M.P., F.R.S., &c. Pp. 473. (London: Macmillan and Co., Ltd., 1896.)