line of the wing-tips does not lie horizontally, but obliquely, so as to describe in moving, a cone, apex downward. This slant gives, through the resistance of the air, a certain degree of rigidity to the system represented by the soaring and circling bird, which corresponds to the rigidity that holds the parts of the top together, and prevents them from flying off in tangents.

Being myself a zoologist, and not a mathematician, I cannot venture to state this hypothesis otherwise than in the shape of a question; perhaps one of the mathematical readers of NATURE will kindly take the trouble to answer it.

Czernowitz, August 23. R. VON LENDENFELD.

THE CONWAY EXPEDITION TO SPITZBERGEN.

THE expedition organised by Sir Martin Conway for the exploration of the interior of Spitzbergen left London on June 2, and first sighted the island on June 17, the exact tercentenary of its discovery by Barentz. The northern ice sheet having broken up exceptionally early this year, the floes off the western coast of Spitzbergen were unusually heavy, and somewhat delayed the arrival in Advent Bay. The expedition landed the stores there on June 20. In accordance with the plan of operations arranged, the members divided into two parties: one party, consisting of Sir Martin Conway, Mr. E. J. Garwood, a well-known geologist and Alpine photographer, and the writer, proceeded to cross Spitzbergen to the east coast. The other party, composed of Mr. Trevor Battye, the ornithologist with the expedition, and Mr. H. E. Conway, the artist, cruised about Ice Fjord and its two chief bays, in order to collect birds and make sketches.

Till the present year very little was known of the interior of the country. The coasts have been carefully surveyed by many expeditions, of which those of Parry and of various Swedish explorers, notably the series organised by Baron Nordenskiöld, are of the first importance. But hitherto the only contributions to our knowledge of the interior were those of the late Gustav Nordenskiöld and M. Rabot. The former marched for three days across the ice-sheet from Hornsund to Bel Sound, along a line parallel to the west coast and some miles inland. M. Rabot made a three days' excursion up a valley going inland from the head of Sarsen Bay. With these exceptions, exploration had been limited to the coast, and to within a day's march of it. Sir Martin Conway therefore took out two ponies and sledges, with which to provision some inland camps. The ponies answered well, but the sledges broke down repeatedly, and thus greatly delayed progress.

The principal geographical work of the expedition was the first crossing of Spitzbergen, from Advent Bay to Agardh Bay. The country traversed was mapped by Sir Martin Conway, while his two companions worked out the geology of the country and made collections of its flora and of its very limited fauna. Subsequently the whole expedition sailed northward to the Seven Islands, and through Kinlopen Strait and across Olga Strait to near King Charles' Islands. An effort to complete the circumnavigation of Spitzbergen was nearly successful, but failed owing to the passages into Sta Fjord being blocked by fast ice. Mr. Garwood and Mr. Battye ascended Hornsund Sind, the highest peak in Spitzbergen.

In regard to the biological results, it is too early to estimate their value, for novelties can only be expected among the invertebrates, which have not yet been examined. The only land mammals are the bear, arctic fox, and reindeer, of which the last are abundant. Birds are individually numerous, but the species are few; of the twenty-five authentically recorded species, we saw all but the snowy owl (*Nyctea nivea*). One addition to the list might have been made, had we been able to carry a gun across the island; for we saw an unrecorded species on the shore of Agardh Bay. Several dredge hauls were made in Advent Bay and Hornsund, yielding various species of worms, mollusca, crustacea, ophuiroids, &c.

Botanical collections were made during the traverse of the island in order to contrast the flora of the inland valley, of the high plateaus, and of the nunataks, with that of the coast. The flora is remarkably uniform, and the influence of height has less effect than those of situation and season. The species found on the mountain summits in the middle of the summer were the same as those found on the coast at the beginning of the spring. As the season advanced the species first found in flower on the lowlands and in sheltered valleys were succeeded by another set; but at any time it was only necessary to seek exposed and barren positions, or to climb above the snow line, to find the first flora still in flower.

Spitzbergen offered better opportunities for geological than for either zoological or botanical work. The rock sequence includes representatives of the Archæan, Lower Palæozoic, Devonian, Carboniferous, Trias, Jurassic, and Middle Tertiary. The coast series has been described by many workers, including Keilhau, Torell, Loven, Lamont, Nordenskiöld, Nathorst, de Geer, and others; but as the interior had not been visited, we had there a fresh field of work. In this I had the good fortune of the co-operation of Mr. E. J. Garwood; together we mapped the belt of country between Advent Bay and Stor Fjord, and made collections from each of all the geological systems that occur in Spitzbergen. Our work was greatly facilitated by the simplicity of the geology of the country; the sections are numerous and clear, and the structure is often shown with diagrammatic clearness.

Our best opportunity for the study of the Archæan rocks was given by the bare cliff sections at Walden Island, one of the Seven Islands situated in lat. 80° 38'. Here we found that this series was formed of a group of schists which have been invaded by two sets of intrusive gneisses; great blocks and seams of the schists are included in the gneisses, while veins from the latter cut upward into the schists.

The general stratigraphical sequence has many points of interest. Great stress is often laid on the absence from Spitzbergen of any indication of glacial action in times earlier than the Pleistocene; and also on the fact that the occurrence of fossil coral reefs, and beds containing warm, temperate, or even sub-tropical plants, shows that the climate before the Pleistocene epoch was quite different from that of the present time. Our evidence, however, greatly simplifies the task of explaining these difficulties; that remarkable changes of climate have happened, is unquestionable. One such is probably in progress still. But these changes of climate are reduced to much narrower limits than seems to be generally considered. We found signs of glacial action in the deposits of, at least, two different eras before those of the "great ice age." Moreover, the so-called coral reefs are not coral reefs, and might have been formed in the adjoining seas; and the fossil plants do not indicate so mild a climate as those of the Miocene beds of Southern Greenland. In fact, the whole of the fossil faunas and floras from the Devonian onward are comparatively poor in species, and appear to have lived under unfavourable conditions, and their existence in Spitzbergen may all be explained by the assumption of only a sub-arctic climate.

One of the main temptations Spitzbergen offers to the geologist is a magnificent opportunity for the study of glacial action; for we may see there marine and land ice working side by side. As our time on the coast was short, we naturally saw most of the inland glaciers. These are very different from those of Switzerland; for example, they have practically no *névé* fields. All the snow that falls on the collecting-ground at the head of the glacier turns to ice *in situ*. Time after time we ascended glaciers, expecting to be soon stopped by

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.