Others, again, place a much higher and more extended value upon their effectiveness as a means of development, and, instead of employing their time to perfect their pupils in the knowledge and use of that language which alone can introduce them to the world of thought and information, exert themselves to extend their acquaintance with natural and methodical signs, and to make them masters of pantomimic action. This to me is a most reprehensible practice and a complete perversion of the true use of signs in the instruction of the deaf.

Concerning the use of signs, Mr. Luzerne Rae says, "A too abundant and constant use of signs is the grand practical error of American institutions for the deaf and dumb."

Dr. E. M. Gallaudet, president of the National Deaf-Mute College, in an able article in the *American Annals*, maintains that "until a deaf-mute can think freely in conventional language, and express his thoughts fluently and correctly in the same, every instance of the use by him or to him of the language of signs in its natural order, impedes his progress toward the great end and object of his education."

In the oral instruction of the deaf, except in the earlier stages, signs as a means of communication should be carefully prohibited; in manual instruction they should be used as sparingly as possible at all stages. If the deaf are to satisfactorily acquire speech and speech-reading, they must early learn to rely upon them for all purposes of communication; and if they are to acquire fluency and correctness in the written forms of the language, they must be required constantly to express their ideas in the same. The continued general use of signs will in either case prove highly detrimental to the great end and object of instruction, and no intelligent teacher will prolong their exercise one moment after they have served their legitimate purpose. Like the scaffolding used in the erection of a building, which, however helpful and necessary during the course of construction, having served its purpose, is cast aside, with the completion of the edifice, as something not only unnecessary to the strength and duration of the structure, but as something, which, if permitted to stand, would prove a most serious debasement of its beauty and utility, so signs, however rapid and convenient and helpful they may be as means of communication and mental development, in the various stages of intellectual growth, having served their purpose, should be rigidly cast aside as debasing and detrimental to that newer and more perfect language which it is their proper function to aid in attaining. A. L. E. CROUTER.

TEMPERATURE IN THE GLACIAL EPOCH.[1]

THE late long frost has naturally suggested the question, "What permanent fall of temperature would produce a recurrence of the glacial epoch?" It is a question not easily answered, for it is like a problem complicated by too many independent variables. It is not enough for us to ascertain the actual temperature of a district in order to determine whether it will be permanently occupied by snow and ice. There are regions where the ground, a short distance below the surface, is always frozen to a depth of several yards at least; and yet glaciers do not occur, even among the hills, because the amount of precipitation is so small that the summer rapidly dissipates what the winter has collected. There are other regions partly covered by ice, though their mean annual temperature is distinctly above the freezing-point; as where glaciers descend to the sea from hilly districts, of which a considerable area lies above the snow-line, and on which there is much precipitation. In the case of Great Britain, at least, a further difficulty enters into the problem; namely, that much controversy still prevails as to the interpretation of the symbols upon which our inferences in regard to the temperature of these islands during the glacial epoch must depend. Some authorities would concede no more than that the highland districts of Scotland, Wales, and England were enveloped in snow and ice, and the glaciers, whether confluent or not, extended from their feet for a few leagues over the lowlands, say, to some part of the coast of Lancashire and of Northumberland; while others desire to envelop a large part of the British Isles in one vast winding-sheet of ice, a corner of which even rested on the brow of Muswell Hill, above the valley of the Thames. The one school regards the bowlder clay of England as a deposit mainly submarine, the product of coast-ice and floating ice in various forms: the other attributes it exclusively, or almost exclusively, to the action of land-ice. Into this thorny question we do not propose to enter. The approximation which we shall attempt — and it can only be a rough one — can be easily modified to suit the requirements of either party.

We will assume throughout that the annual isothermal of 32° coincides with the line of permanent snow. This, obviously, is an assumption. Often, owing to small precipitation, it will be found to be erroneous; but we take it as the only simple approximation, for, under favorable circumstances, masses of ice may protrude beyond it.

The question, then, may be put in this form: "Assuming a sufficient amount of precipitation, what changes of temperature are required in order to bring within the isothermal of 32° regions which are generally admitted to have been occupied by land-ice during some part of the glacial epoch?"

First, in regard to the British Isles. All will admit that in many places the Cumbrian and Cambrian glaciers descended to the present sea-level. The mean temperature of the Thames valley near London is 50° F. This isotherm cuts the Welsh coast a little east of Bangor. Obviously, the whole region north of this line has a lower mean temperature; no part of the British Isles, however, being below 45°. Hence a general fall of 18° would give a temperature of 32°, at most, in the Thames valley and on the shores of North Wales (except on the extreme west), while on the coasts farther north the temperatures would range down to 27°. What would be the effect of this? Switzerland may enable us to return an answer. The snow-line in the Bernese Oberland may be placed roughly at 8,000 feet above the sea, but it is obvious that the chief feeding-ground of the Alpine glaciers lies rather higher up in the mountains. In the case of such glaciers as the Great Aletsch, or the Aar, the lowest gaps in their upper basins are rather above 10,000 feet; while the surrounding peaks range, roughly, from 12,000 to 14,000 feet, though but few exceed 13,000 feet. Thus the feeding-ground of the Oberland glaciers may be regarded as equivalent to a mountain district the sky-line of which ranges from rather above 2,000 to 5,000 feet. In reality, however, not very much of it exceeds 4,000 feet above the snow-line. This, indeed, rather overstates the case. We find practically that the effective feeding-ground, that which gives birth to glaciers, which protrude for some distance below their supply-basins, may be placed about 1,000 feet above the ordinary snow-line; so that the glacier-generating region of Switzerland may be regarded as equivalent to a mountain district with passes about 1,500 feet, and peaks not often exceeding 3,000 feet. It follows, then, that if the temperature at the seacoast in North Wales were 32°, the whole of the Scotch Highlands, and a large part of the Cumbrian and Cambrian Hills, would become effective feeding-grounds, and the glaciers would be able to descend into the plains. In the Alps, the larger glaciers terminate at present at altitudes of from 4,000 to 5,500 feet (approximately); that is, they descend on an average about 4,000 feet below the effective feeding-ground, or 3,000 feet below the snow-line. If the temperature of Bangor were not higher than 32°, then the Snowdonian district would be comparable with one of the Alpine regions where the mountains rise generally from about 1,000 to 3,000 feet above the snow-line; that is, with such a one as the head of the Maderanerthal, where none of the peaks reach 12,000 feet above the sea. Here the Hüfi Glacier leads to passes rather below 10,000, among peaks of about 11,000 feet in altitude, and it terminates a little above 5,000 feet;

[1] From Nature.

that is to say, a region, rising roughly from 2,000 to 3,000 feet above the snow-line, generates a glacier which descends more than 2,000 feet below it.

But what change is required to give a glacial epoch to Switzerland? It is generally agreed that an ice-sheet has enveloped the whole of the lowland region between the Alps and the Jura. Let us assume, that, other conditions remaining the same, this could occur if the mean annual temperature of this lowland were reduced to 32°. Its present mean temperature varies somewhat; for instance, it is 45.86° at St. Gall, 49.64° at Lausanne. Let us take 47.5° as an average, which is very nearly the mean temperature of Lucerne.[1] So this lowland requires a fall of 15.5°. We may take the average height of the region as 1,500 feet above the sea. If, then, we begin the effective gathering-ground at 1,000 feet higher, the valley of the Reuss from well below Wasen, and the valley of the Rhone from a little above Brieg, would be buried beneath *névé:* so that probably a fall of 16° would suffice to cover the lowland with an ice-sheet, and possibly bring its margin once more up to the Pierre-à-bot above Neuchâtel; at any rate, a fall of 18° would fully suffice, for then the mean temperature of Geneva would be slightly below 32°.

The line of 41° passes through Scandinavia a little north of Bergen. If, then, the climate of Norway were lowered by the same amount, which also is that suggested for Britain, the temperature at this part of the coast would be 23°, corresponding with the present temperature of Greenland rather south of Godhavn, and probably no part of Norway would then have a higher mean temperature than 26°.

The wants of North America are less rather than greater; though, as geologists affirm, an ice-sheet formerly buried all the region of the Great Lakes, and descended at one place some fifty leagues south of the 40th parallel of latitude. Its boundary was irregular; but, if we strike a rough average, it may be taken as approximately corresponding with the present isotherm of 50°. The temperatures, however, in North America fall rather rapidly as we proceed northwards. Montreal is very nearly on the isotherm of 45°, and this passes through the upper part of Lakes Huron and Michigan; that of 39° runs nearly through Quebec and across the middle of Superior; while at Port Arthur, on the same lake, the temperature is only 36.2°. If, then, we assume sufficient precipitation, the maximum fall of temperature required for this North American ice-sheet will be 18°; but less would probably suffice, for the district north of the St. Lawrence would be a favorable gathering-ground. This would be brought within the isotherm of 32° by a fall of 12°, or, at most, of 13°.

It seems, then, that if we assume the distribution of temperature in the northern hemisphere to have been nearly the same as at present, we require it to have been lowered, at any rate in the regions named, by about 18°, in order to bring back a glacial epoch. For North Wales a reduction of about 20° might be needed; but, if the isotherms ran more nearly east and west, 18° for the Thames valley might suffice. If we assume the great extension of glaciers in central and north-western Europe to be contemporaneous with that in America, we must suppose that these parts of the northern hemisphere had a climate more nearly resembling, but even colder than, that which now prevails in the southern hemisphere. The isotherm of 40° runs a little to the south of Cape Horn: that of 45° passes north of the Straits of Magellan. The latter lie on parallels of latitude corresponding with those of North Wales, but their mean temperature is about 8° lower. If we could restrict ourselves to the British Isles, it would be enough to assume a different distribution of temperature from that which now prevails on the globe, for at the present time, and in the northern hemisphere, the isotherm of 32° twice comes down very nearly to the latitude of London; but it may be doubted whether this alone would account for the great extension of the Alpine glaciers, and the difficulties seem yet greater in the case of North America. Here, where even at present the temperature is rather abnormally low, we have to make a very considerable reduction. But this is too wide a question to discuss at the end of an article in these pages. We seem, however, fairly warranted in concluding that, whatever may have been the cause, a lowering of temperature amounting to 18°, if only the other conditions either remained constant or became more favorable to the accumulation of snow and ice, would suffice to give us back the glacial epoch.

T. G. BONNEY.

[1] St. Gall, 45.86° F.; Berne, 46.58°; Lucerne, 47.48°; Zurich, 48.20°; Neuchâtel, 48.74°; Geneva, 49.46°; Lausanne, 49.64°. St. Gall and Berne are rather high stations, the one being 2,165 feet, the other 1,760 feet. The lake of Lucerne is 1,437 feet above the sea.

A NEW DEPARTURE IN DEAF-MUTE EDUCATION.[1]

THE attention of instructors of the deaf and their friends has in various ways within the past few months been called to a proposal, very briefly outlined in the annual report of the Columbia Institution, for the enlargement of the facilities for normal training already existing in this college.

Misapprehensions have naturally arisen as to what was proposed, because, in the absence of any official utterance, unauthorized persons have taken it on themselves to publish conclusions based purely on presumptions, or, in some instances, on incomplete statements and perverted inferences.

As the plans of our directors for the "new departure" are now measurably complete, final action having been only reached in a meeting of the board held this day, I take pleasure in announcing that the teaching force of our institution will be increased next year by the employment of an experienced instructor in articulation, who will be especially devoted to the promotion of speech and lip-reading in the college.

Liberal provision has recently been made for this object by Congress.

The directors have to-day established six normal fellowships, of the value of five hundred dollars each per annum, to which graduates of colleges will be appointed for one year. These fellows will be required to reside in the institution, and will receive instruction in both the manual and the oral methods of teaching the deaf. They will, in view of the advantages to inure to them from these fellowships, be expected to perform certain duties in the institution, and will therefore constitute a distinct addition to its teaching force.

The funds for sustaining these fellowships are at the disposal of the board from sources other than the treasury of the United States.

The suggestion of establishing these fellowships, with a view of training instructors of the deaf of the highest grade, is taken from the arrangement existing in the Johns Hopkins University at Baltimore, from the ranks of whose fellows college professors, principals of high schools, and other instructors of high rank, are drawn in large and increasing numbers.

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, MD., March 5, 1891.

Dr. E. M. GALLAUDET,
President National Deaf-Mute College.

Dear Sir, — I am very much interested in what you have told me of your plans and hopes for the development of the National Deaf-Mute College. Particularly it seems to me wise that you should give prominence to the fact that articulation is taught, by designating a competent instructor who should have a specific title indicating that he performs this service. I am even more interested in what you say of the possibility of enlisting annually half a dozen or more men in the service of the college, who would not only be valuable assistants during their residence with you, but would be trained for permanent careers in the various institutions of the land. Such a system here has been most fruitful in good results, and I can easily foresee how a carefully chosen staff of associates or fellows in the National Deaf-Mute College, holding an intermediate position between the permanent members of the faculty on the one hand, and the students on the other, would inspire the teachers, help the scholars, and furnish, in time, a corps of instructors for the schools for the deaf, which now exist in such considerable numbers throughout the country.

Yours sincerely,
D. C. GILMAN.

The above letter from President Gilman had much weight with our directors in their deliberations to-day.

[1] Circular of Information issued by the National Deaf-Mute College, Washington, D.C., March 7, 1891.