they are met with: but are rarely associated with the foliage figured as *S. Sternbergi*, none having been found at such important localities as Sotzka, Häring, Monte Promina, and Bilin, where foliage abounds. This absence of cones is very strong negative evidence against their foliage in the above localities at least being Sequoia, and in favour of their being Araucaria. The cones of Araucaria are few and large, shaken to pieces by the wind almost as as soon as ripe, and when carried by water the flotation of the winged seeds and of the foliage would differ enough to lead to their being separately imbedded. The foliage was described for years as *Araucarites*, and a well-defined immature cone of Araucaria was found in the deposit at Häring and figured by Sternberg [1] and by Goeppert [2] as *Araucarites Goepperti*, and afterwards considered by Unger and Ettingshausen [3] to belong to *A. Sternbergi*. Another small Araucaria-like cone is figured by Massalongo from Chiavon,[4] which was found associated with foliage identical with that from Bournemouth. Similar foliage, but still nearer to Araucaria, is found at many places in France, and in England at Sheppey, Bournemouth, Bracklesham, the Isle of Wight, &c., but also always without any Sequoia cones, although I have found an Araucaria cone at Sheppey.

Against all this evidence we have to set the fact that a branch with compressed cones attached has been found in the Upper Miocene near Turin, and that Sequoia cones are found in the same strata with somewhat similar foliage in Iceland. In both these instances however the foliage differs materially from the typical *S. Sternbergi* of Sotzka. If we consider that foliage of existing species of Araucaria, Sequoia, Cryptomeria, and Arthrotaxis can with difficulty be distinguished, and that species which have died out may have approached each other still more closely, the evidence upon which Heer has changed the determination of all the Austrian and German specimens must appear insufficient. The possibly accidental similarity, not identity, of foliage occurring in deposits far apart and of widely different age, does not, I hold, outweigh the other facts I have advanced.

This type of foliage, whether it belong to one or many genera, has not been found of Tertiary age north of Iceland, nor in the newer Miocenes of Central Europe, if we set aside two more than doubtful fragments from Oeningen. It abounds however in England, France, Germany, and Austria in Eocenes and Oligocenes, and recurs, as an Upper Miocene form, in Italy only.

The British Eocenes have been credited with several Sequoias, as *S. Sternbergi* and *S. Bowerbankii* from Sheppey, *S. Langsdorfii* from Alum Bay and Bournemouth, *S. du Noyeri* from Antrim, &c., &c. There is, I believe, no good evidence yet of the presence of any Sequoia except *S. Couttsiæ*, confined to Bovey, Hempstead, and perhaps Bournemouth, in any Tertiary rock of Great Britain. This question however cannot here be profitably discussed. *S. Couttsiæ* was originally described by Heer from Bovey Tracey, where it literally abounded. The foliage resembles that of *S. gigantea*, though smaller and more delicate, and must have been very graceful; but Heer's restoration of it, since copied into other works, is very stiff and unnatural. The foliage in the "Flora fossilis arctica" is much coarser, and should not have been referred to the same species. Saporta describes a beautiful variety "*Polymorpha*" from Armissan, in which the ultimate branchlets take on the *sempervirens* character. *S. Couttsiæ* seems to have been capable of supporting considerably greater heat than any of the other species, if we may judge from the associated plants.

The leading facts known to us respecting the past history of the Sequoias may be summed up thus. They are not known to be older than the Cretaceous, when they were principally a northern form. The differentiation of the existing types has progressed from that period to the present, being slight in the Cretaceous (*e.g. S. Reichenbachii*); more pronounced in the Eocene (*e.g. S. Couttsiæ v. polymorpha*); yet more so in the Oligocene and Miocene (*S. Langsdorfii*), and most so at the present day, though even now there is a tendency to approach each other. The number of fossil species should be considerably reduced, and much of the supposed Sequoia foliage transferred to other genera. The genus is known to have ranged as far south as Central Europe during the Cretaceous, seems to have retreated north during the Lower and Lower Middle Eocenes, re-occupied its former habitats in the Upper Middle Eocene and Oligocene, first through *S. Couttsiæ*, and then through *S. Langsdorfii*, and ranged into Italy during the Upper Miocene. It was well-nigh exterminated during the Glacial epoch, and has been strangely preserved in two isolated spots, perhaps beyond its original range, where the moderating influence of the Pacific enabled it to survive on, or occupy at a remote period lofty mountain spurs between the sites of ancient glaciers. Fixed on exceptionably favourable stations with congenial soil, the existing species may have slowly adapted themselves to a temperature far more genial than that supported by their polar ancestors, and, in adapting themselves to an always increasing mildness, have acquired that stupendous habit of growth which makes them the giants of vegetation.[1]

The moral to be drawn from the history of the Sequoias is that we should not place implicit credence in the minimum temperature of the so-called Miocene Greenland, Spitzbergen, Vancouver's Isle, Sitka, and Arctic America and Asia, as settled by Heer. Such bald argument, as for instance that because Sequoia now requires such and such a temperature, therefore former but different species must have required the same, is entitled to but little deference; yet Heer's facts and opinions are quoted as axioms by a wide range of workers. When examined they are seen to be disputable, whether taken as physiological, geological, palæontological, or any other data. Provisionally they were of use, but the questions depending on the accuracy of the data are so important and the evidence so intricate that they should not be deemed settled until some greater amount of care has been bestowed on them.

J. STARKIE GARDNER

[1] "Verst.," vol. ii. p. 204, Pl. 39, Fig. 4.
[2] "Monogr. foss. Conif.," 1850, Haarlem *Trans.*, p. 237, Pl. 44, Fig 2.
[3] "Flora von Häring," p. 36. [4] "Specim. Photogr.," pl. xxi.

GEOMETRICAL TEACHING[2]

WE are glad to see that the Association for the Improvement of Geometrical Teaching has been by no means idle, though no report has been issued since January, 1878, but that there has been a good deal of silent work going on in the way of sub-committee discussions upon the several syllabuses of solid geometry, of higher plane geometry, and of geometrical conics. All who know the president will heartily sympathise with him in his bereavement, and will understand how unfitted he must have been for any other work than that which his position at Harrow imperatively required of him. He has now thrown himself with much energy into the cause, and proof of his interest in the labours of the Association is manifest throughout the interesting address which is printed on pp. 12-17 of this Report. It is well known that he has long advocated an extension of the scope of the Association, and in this address he takes the opportunity of putting his views well forward.

"It was doubtless well at the outset of our work to concentrate our attention and confine our efforts to the definite field, in which perhaps the need for improvement

[1] If we can really trace back the history of *S. gigantea* to fossil forms, it becomes curious to notice that it is only now approaching *S. Couttsiæ*, the type which there is reason to believe formerly supported the highest temperature of any Tertiary Sequoia.
[2] Association for the Improvement of Geometrical Teaching. Seventh General Report, January, 1881.

was most pressing, that of the teaching of geometry. But it can hardly be denied, I think, that there are other branches of mathematics whose teaching might also be greatly improved by an association of teachers, conferring together as to the defects of existing books or methods, and intrusting to sub-committees the task of suggesting means of remedying such acknowledged defects. If this be granted it appears to me that it is our next duty to bring the strength of our existing organisation to bear on other branches of mathematics besides pure geometry. To do this would, I believe, assist rather than injure the work which we have still to do for geometry.

"I cannot doubt but that we have to some extent suffered from the restriction of the field within which we have hitherto worked. Elementary geometry is essentially a *school* subject, that is, one in which a student of mathematics ought to be fairly proficient before he enters on his university course, and which therefore is not a subject of *real teaching* in our universities or higher colleges at all. To this, and not to any ingrained spirit of opposition to improvement, which in the face of the changes going on in our universities it seems to me it would be absurd to charge upon any body of active workers therein, I am inclined to attribute the small amount of interest and attention which we have hitherto been able to obtain for our work, and our failure as yet to procure any recognition of our syllabus in any university of the United Kingdom. Where a subject is not taught, but is only a subject, and rather a subordinate subject, of examination, there can hardly be any very lively and active interest in the improvement of its teaching. It is reasonable to expect, therefore, that, by extending the scope of our work to other subjects, of which only the elements can in general be taught in schools, and which will afterwards be more fully studied at the universities, we shall enlist the sympathies of a wider circle of mathematical teachers, extend the list of our members, and connect ourselves more intimately with the living mathematical teaching of our universities, and then we shall, I believe, greatly promote the recognition of the work which we have already done. . . . . Algebra and trigonometry are perhaps less in need of our attention than other subjects, though even as regards these I believe valuable suggestions as to improved methods and range of teaching would arise in the discussion of a committee specially interested in them. But it is only necessary to mention the subjects of analytical geometry, higher geometry, higher algebra, elementary kinematics and dynamics (or mechanics), to bring before the minds of those whom I am addressing a number of questions as to their teaching, from the discussion of which great advantages might arise. Further, I think no one can have followed the more recent expositions of mathematical physics, more especially in the 'Matter and Motion' of Maxwell, and the 'Elements of Dynamic' (alas, only a fragment) of Clifford—to mention only the names of two of the most penetrative geniuses and profound thinkers of our age, whom we have loved and admired while living, and whose premature deaths we, in common with the whole world of mathematical and physical science, deplore as an irreparable loss—without feeling convinced that the time is not far distant when the notion of a *vector* or *step*, as Clifford happily names it, and the simpler consequences of that notion forming a *vector* or *step*-geometry (the basis of the calculus of quaternions), must be made a part of the elementary studies of every student of mathematics, more especially for the purposes of mathematical physics, but perhaps not less for its application to pure geometry. And if this be so I cannot help thinking that our Association, extended as I have suggested, might be the means of bringing together the right men to organise the method and bring it into a suitable stage for elementary instruction . . . I refer to the improvement of the teaching of arithmetic. I suppose there are none of us here who have had any experience in the teaching of arithmetic, who have not often wished that they could make a *tabula rasa* of their pupils' minds, as regards this subject, so fatally destructive of all appeals to reason have early unintelligent teaching and bad traditional methods shown themselves to be. In an effort to reform in many points the teaching of arithmetic, we might naturally expect to associate with us the best teachers in preparatory and even in primary schools; and perhaps also members of that very important body of men, the Government Inspectors of Schools; and thus our organisation might become the means of linking together all grades of mathematical teachers, from the humblest to the highest, in an association which could not fail, if heartily supported, to become a powerful influence for good on the whole education of the country."

As the President's proposal took many of the members present by surprise, it was ultimately resolved, as we read, that a special meeting of the Association should be held about Easter next, to consider the desirability or the contrary of thus extending the scope of the Association.

In connection with this matter we have also received a letter addressed to non-members to ascertain, if such an extension of the aims of the Association were adopted, whether they would allow themselves to be proposed as members of the new Association. A draft of rules accompanies the Report, from which we extract the following proposed rules:—"That the Association be called 'The Association for the Improvement of Mathematical Teaching'; that its object shall be to effect improvements in the teaching of the various branches of elementary mathematics and mathematical physics by such means as may appear most suitable in each particular case. This object to be carried out by the reading of papers or raising discussions at meetings of the Association, by the appointment of committees to report on existing defects in the usual methods, order, range, &c., in teaching special subjects, and the expediency of drawing up syllabuses or text-books of such subjects; by the employment of suitable means for bringing the work done by the Association before the universities and other educational or examining bodies, and using its influence to obtain recognition of such work from those bodies."

Another action on the part of the meeting was the passing a resolution "that a sub-committee be appointed to draw up proofs of the propositions of the syllabus of plane geometry." It was shown that many teachers had adopted the syllabus, and that it was meeting with a growing acceptance was evidenced by the steadily improving annual sale, 2033 copies having been already sold.

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION[1]

II.

NORTH-EASTERN ASIA has of late years disclosed to its explorers a number of very curious novelties in the class of Mammals. Amongst them are several species of great interest, examples of which have reached the Gardens of the Zoological Society alive.

4. The Tcheli Monkey (*Macacus Tcheliensis*) was so named by the distinguished zoologist, M. Alphonse Milne-Edwards of Paris, from the Chinese province of Tcheli (or Petcheli), in which it is found. The existence of a monkey in a latitude so far north—on nearly the same isothermal line as the city of Paris—is a very remarkable fact, and quite new to zoological distribution.

The occurrence of this monkey in the mountains of the north-eastern district of the province of Petcheli seems to have been first ascertained by M. Fontanier, who was for some years French Consul at Pekin, and who transmitted

[1] Continued from p. 38.