or more particular trades. (4) For University Colleges a grant similar to that made to training Colleges for education afforded to persons intending to become teachers.

The resolutions are as follow:—

1. That public funds (rates and taxes) should not be employed to meet the current expenses of teaching specific trades.

2. That it is undesirable that instruction in the use of tools should be introduced into primary schools as a grant-earning subject.

3. That with a view to preparing pupils for technical education later on—

(*a*) The grant to day-schools should depend, to a much less extent than at present, on the results of the examination of individual pupils in reading, writing, and arithmetic, and should be largely dependent on the inspector's report of the general character of the teaching and the equipment of the school.

(*b*) There should be greater liberty in the choice of subjects in primary schools, and the same class subject should not necessarily be taken throughout the school.

(*c*) The grant to evening continuation schools should be regulated by the report of the inspector on the character of the teaching, and on the attendance list, and not upon the result of the examination of individual pupils.

4. That when a technical school is combined with a science and art school, the contribution to the building fund, through the Science and Art Department, should exceed £1000, if, in the opinion of the Department, the requirements of the locality demand it.

5. That it is desirable that, when specific trades are taught in technical schools, the practical teaching of each trade should be under the general direction of a committee, consisting mainly of members of that trade; that the teaching should be given in the evening, and be restricted to pupils actually engaged in the respective trades, and that, when specific trades are taught, any deficiency in current expenses should be guaranteed by the trade of the district.

6. That a certain percentage of persons preparing for appointments as teachers in elementary schools should be allowed to attend lectures and laboratory work at Universities and University Colleges, where a curriculum satisfactory to the Education Department is provided, and that the same grant should be made on account of such students as in the case of ordinary training Colleges.

7. That it is desirable that University Colleges in which higher scientific and technological training are combined should be assisted by a Government grant, provided that evening instruction is given in all the subjects taught, at fees which shall bring the advantages of the College within the reach of all classes. The due administration of the grant should be secured by the appointment of certain nominees of the Government on the Executive Council of the College.

THREATENED SCARCITY OF WATER.

THE appendices to the Weekly Weather Reports for the year 1887, recently published by the Meteorological Office, contain some interesting details relative to the rainfall. It is shown that the mean rainfall for the whole of the British Islands during 1887 was only 25·8 inches, whereas the mean for the twenty-two years 1866 to 1887 was 35·3 inches, so that there is a deficiency of nearly 10 inches over the whole area of the British Islands, or 27 per cent. less than usual. In the wheat-producing districts, which comprise the east of England and Scotland, the south of England, and the Midland Counties, the fall during 1887 was 21 inches, and the average value for twenty-two years is 28·5 inches, showing a deficiency in these parts of the Kingdom of 7·5 inches, or 26 per cent. less than usual. In the principal grazing districts, which comprise the west of England and Scotland, as well as Ireland, the fall in 1887 was 30·5 inches, and the value for the twenty-two years is 42·0 inches, showing a deficiency of 11·5 inches, or 27 per cent. less than the average. In the north-west of England the rainfall for 1887 was only 24·9 inches, which is 15·7 inches or 39 per cent. less than the average, and in the south-west of England the fall was 28·3 inches, which is 16·6 inches or 37 per cent. less than usual. Last year was the driest of any year since 1866, and this feature was common to all parts of the United Kingdom; the amount of rain measured was only about one-half of that recorded in 1872, which was the wettest year of the period. If the comparison is confined to the last ten years, the deficiency is nearly as marked, and 1887 is still found to be about 25 per cent. below the average, but the greatest deficiency in this case occurs in the Midland Counties, where it amounts to 36 per cent. of the average. The reports issued by the Meteorological Office for the first five or six weeks of the present year show the deficiency of rainfall still to be augmenting, and even more quickly than in any period last year. In the Midland Counties the rainfall to February 6 was only 0·6 inch instead of 2·9 inches, so that the deficiency from January 3 is as much as 79 per cent. of the average fall; and at Hereford, where the total fall is only 0·29 inch, the deficiency is 90 per cent. of the average. In the east of England the deficiency is 64 per cent., in the south-west of England 61 per cent., and in the north-west of England 58 per cent. There has been a deficiency of rain in all districts of England each week for seven consecutive weeks since December 19, with the exception of a single district (England N.E.) in one week, and since the beginning of October there have been but four weeks in which the excess of rain was at all general. Out of fifty-seven weeks since the commencement of 1887 there have been but ten in the south-west and east of England with an excess of rainfall, and only eleven in the north-west of England. With these facts to hand, there seems reasonable ground for alarm being felt in some localities at the threatened scarcity of water.

CHARLES HARDING.

PROFESSOR ASA GRAY.

WHEN the history of the progress of botany during the nineteenth century shall be written, two names will hold high positions: those of Prof. Augustin Pyrame De Candolle and of Prof. Asa Gray. In many respects the careers of these men were very similar, though they were neither fellow-countrymen nor were they contemporaries, for the one sank to his rest in the Old World as the other rose to eminence in the New. They were great teachers in great schools, prolific writers, and authors of the best elementary works on botany of their day. Each devoted half a century of unremitting labour to the investigation and description of the plants of continental areas, and they founded herbaria and libraries, each in his own country, which have become permanent and quasi-national institutions. Nor were they unlike in personal qualities, for they were social and genial men, as active in aiding others as they were indefatigable in their own researches; and both were admirable correspondents. Lastly, there is much in their lives and works that recalls the career of Linnæus, of whom they were worthy disciples, in the comprehensiveness of their labour, the excellence of their methods, their judicious conception of the limits of genera and species, the terseness and accuracy of their descriptions, and the clearness of their scientific language.

Asa Gray was born in Paris, Massachusetts, on November 18, 1810, and took his M.D. degree when twenty, at the Medical College of Fairfield, Oneida County. His proclivities were all scientific from a very early age, and he is said to have, whilst still a student, delivered lectures on chemistry, geology, and botany, in private establishments of that county. The two former subjects were at first his favourites—indeed, his earliest

contribution to science is a paper, by G. B. Crawe and himself, on the mineralogy of Jefferson and St. Lawrence Counties (N.Y.), in *Silliman's Journal* (1834, 346)—but they soon gave place to botany, owing to his having attracted the attention of Dr. John Torrey, State Botanist for New York, and Professor of Chemistry and Botany, but practically of botany only, in the New York Medical College. In 1833, Dr. Torrey made Gray his laboratory assistant, a post he held for some months, during which he presented what was his first botanical paper to the Annals of the New York Lyceum. This, which was on a very intricate and much misunderstood group of American sedges (*Rhynchospora*) showed Gray's acuteness as an observer, and skill in systematizing, as clearly as anything he has since written. In the following year he was appointed Curator of the New York Lyceum, where he extended his studies to the North American grasses and Cyperaceæ, and prepared his first botanical text-book, which was published in 1836, under the title of "Elements of Botany." The "Elements" is a noteworthy book; it was at once accepted as the best that had appeared in the States, and as second to none in the English language; its only rival was Lindley's "Introduction to the Natural System of Botany," the first edition of which had (in 1831) been reprinted under Dr. Torrey's supervision for the use of the American schools.

Whilst still attached to the New York Lyceum, Gray accepted the appointment of naturalist to Capt. Wilke's South Pacific Exploring Expedition, which was then being fitted out; but after two years' delay, and the curtailment of the opportunities for research that were to have been afforded him on the voyage, he threw up the appointment. This result is much to be deplored, for no young naturalist was ever better fitted by education, and by training as an observer and collector, to have taken advantage of the splendid opportunities which that expedition afforded.

Having relinquished the prospect of Pacific exploration, Dr. Gray was invited by his friend Dr. Torrey to co-operate with him in the preparation of a flora of the North American Continent; and into this work, which became the leading object of his scientific life, he eagerly entered. At the same time he accepted the Chair of Botany in the University of Michigan, subject to the condition of being allowed a year's leave to be passed in Europe for the purpose of verifying the nomenclature of the American flora by a study of the species of which the types existed only in European herbaria. This was in 1838, and his first visit was to Glasgow, where the then Professor of Botany (Sir W. Hooker) was engaged on a flora of British North America, under the auspices of the Secretary of State for the Colonies. After a long sojourn in Glasgow, Dr. Gray visited the principal herbaria in London, France, Switzerland, Italy, Austria, and Prussia, making life-long friendships with scientific men of all pursuits wherever he went; his letters of introduction, coupled with his bright intelligence, genial disposition, and charming personality, giving him the *entrée* to *salons* as well as to the museums of every capital. This was the first of seven visits that Dr. Gray paid to Europe, and of which the last was concluded a very few weeks before his fatal illness.

On his return to America in 1839, Dr. Gray resided at New York, when the first volume of the flora of North America was completed, in conjunction with Dr. Torrey, and the second, elaborated wholly by himself, was begun, but not completed till 1843. In the meantime (in 1842) he had been appointed by the Fellows of Harvard College, Cambridge, Fisher Professor of Natural History, the duties of which Chair were restricted to an annual course of lectures on botany, and the charge of the College Botanical Gardens, to which an official residence is attached. This was his home for the rest of his life, and here, with funds partly derived from the College, and partly from private sources, largely supplemented by interchanges of specimens and books, he founded the Harvard Herbarium and Library.

The great desideratum for the conduct of Dr. Gray's new duties was a much fuller class-book of botany than the "Elements" of 1836, and in the same year he completed the first edition of his "Botanical Text-book." In this the subject-matter is divided into two parts, one devoted to structural and physiological botany, the other to the principles of systematic botany, including chapters upon plants useful to man. This was the first of a series of editions of a work that has been for nearly half a century the text-book of schools and colleges throughout the United States, and the latter issues of which have been generally recommended by the botanical professors of the United Kingdom as the best of its class. In 1880 the first volume of the sixth edition appeared, but the advances in botanical science made since the fifth was published, quite a quarter of a century before, had been so many and great that the amount of matter which this sixth will contain is quadruple that of the fifth. It will be when complete a co-operative work in four volumes. The first is by Gray himself, and is devoted to morphology, taxonomy, and phytography; the second, by Prof. Goodale, Gray's able successor in the Fisher Professorship, includes vegetable histology and physiology; the third, by Prof. Farlow, will treat on Cryptogams; and the fourth, which Dr. Gray reserved for himself, was intended to be occupied by the classification of Phænogams, their special morphology, distribution, and products. Gray's other educational works are: "Lessons in Botany and Vegetable Physiology," somewhat on the plan of Lindley's "School Botany," but much fuller; also two smaller works, that for charm of matter and style have no equal in botanical literature—"How Plants Grow," and "How Plants Behave"—they rival chapters in Kirby and Spence's introduction to entomology in instruction and interest; and lastly, "Field, Forest, and Garden Botany."

The great outcomes of Gray's labours in systematic botany are his works on the flora of North America, from the Arctic islands to Mexico, and from the Atlantic to the Pacific Ocean. In one form or another these embrace a great proportion of the 10,000 or 12,000 species which that continent is supposed to contain. More than half are included in the two volumes published in conjunction with Torrey, and in his "Synoptical Flora," of which two parts are published, and in his "Manual of the Botany of the Northern States." The remainder are described or mentioned in more or less detail in multitudes of detached papers, and especially in memoirs upon collections made by naturalists attached to the many Expeditions organized by the Government for the exploration of railway routes across the continent, and by collectors and private individuals in previously unexplored regions. It was the hope of their author that the publication of these collections would have accelerated the completion of the general flora, and such would have been the case had their author lived; but as it is, the stars have in great measure obscured the planet, for one of the greatest obstacles to the study of North American plants is the multitude of these detached memoirs, with complicated titles, in which so many genera and species are to this day buried. If the great work cannot be continued, as it is to be hoped it may be, by Dr. Gray's most competent herbarium keeper, Sereno Watson, it is most desirable that the contents of these memoirs should be reduced to a systematic form with the least possible delay.

Next to the synoptical flora, Dr. Gray's most original work is his "Genera Floræ Boreali-Americana Orientalis," which was intended to contain descriptions, with figures, of every genus of the Eastern States, with discussions upon their affinities, morphology, and distribution. Only two volumes had appeared when want of funds decreed its end. As a fragment it is unique, and had it but been

completed it would have been of great morphological value. To have done this would, however, have required more than the ten volumes that were regarded when the work was commenced as sufficient to complete it, and this independently of the Cryptogams.

Nor was Dr. Gray's all closet work: he diligently collected and observed over a considerable area of his native continent; along the Altantic coast from Canada to Florida; in the prairie and Rocky Mountain regions from Wyoming to the borders of New Mexico; in the great basin of Utah and Nevada; and along the Pacific coast from Oregon to St. Barbara.

With two notable exceptions, Dr. Gray confined his descriptive work to North American botany. These exceptions were: one, the fragmentary botany of Wilkes's South Pacific Exploring Expedition, with the execution of which he was intrusted, but which came to an end before it was half finished, for want of funds it is believed, after the publication of one quarto volume with a superb atlas of plates; the other is a memoir on the flora of Japan, founded chiefly on the collections made in that country by the United States North Pacific Exploring Expedition, which in point of originality and far-reaching results was its author's *opus magnum*. By a comparison of the floras of Japan with those of Eastern and Western America, and of these with one another, and all with the Tertiary floras of the Northern States, he drew in outline the history of the vegetation of the north temperate hemisphere in relation to its geography, from the Cretaceous period to the present time. It is a brilliant generalization, bearing the unmistakable stamp of genius.

It remains to allude to Gray's admirable defence of the doctrine of "the origin of species by natural selection," of which he, as one of a favoured few, had been fully informed by Darwin himself in 1857 ("Life and Letters," ii. 120), before it appeared in the Linnean Journal. His opinion, which was, from the first, cautiously favourable, but with reserve, soon ripened into a conviction of the truth of the principles involved. He alludes to it first in the concluding remarks to his essay on the flora of Japan, cited above, published in 1859, wherein he says that he is "disposed to admit that closely related species may, in many cases, be lineal descendants from a pristine stock." Again, in a letter to Mr. Darwin, dated early in July 1860, speaking in terms of highest praise of the "Origin," the following passages occur:—"The moment I understood your premisses, I felt sure that you had a real foundation to hold on. Well, if one admits your premisses, I do not see how he is to stop short of your conclusions, as a probable hypothesis at least." And, referring to his own review of it in *Silliman's Journal* (March 1860), he says:—"It naturally happens that my review of your book does not exhibit anything like the full force of the impression the book has made upon me. Under the circumstances, I suppose I do your theory more good here by bespeaking for it a fair and favourable consideration, and by standing non-committed as to its full conclusions, than I should if I announced myself a convert; nor could I say the latter with truth." It may be remarked here that just at this time a battle over species was raging in America, of which but faint echoes reached our shores. This was over the question of the single or multiple origin of species by creation. Gray was the champion of single creations, and, believing himself strongly supported by theological considerations, may well have felt that the further leap to evolution was one into the dark. Be this as it may, for the five years following the publication of the "Origin," Gray devoted himself to impressing upon the American public his opinion of its extraordinary merits by reviews in weekly and monthly periodicals, by lectures, and by discourses at scientific Academies. Latterly (in 1876) he collected many of these into a single volume which he entitled "Darwiniana." In it he defines his own position "as one who is scientifically, and in his own fashion, a Darwinian, philosophically a convinced theist, and religiously an acceptor of the 'creed commonly called the Nicene,' as the exponent of the Christian faith." From this position he never moved, and he subsequently delivered two lectures in further exposition of these views, at the Divinity School of Yale College. These were published in 1880, under the title of "Science and Religion." Finally, Mr. Darwin, whilst fully recognizing the different stand-points from which he and Gray took their departures, and their divergence of opinion in some important matters, regarded him as the naturalist who has most thoroughly gauged his work, and as a tower of strength to himself and his cause.

As a reviewer and bibliographer, Gray's labours must have been Herculean, and they were uninterrupted for nearly half a century. Even when on his travels in Europe, he was in the habit of contributing scientific notices to periodicals in the States. In 1836 he commenced writing reviews of botanical works, and notices of botanists, travellers, and collectors for *Silliman's Journal of Science and Arts*; and this function he continued to perform without intermission (latterly as a co-editor of that important periodical) till within a few days of his last illness. The number of these articles is truly astonishing, as is the knowledge they display of all branches of botany, Phænogamic and Cryptogamic. They are without exception just, sober, and discriminating, critical rather than laudatory, and eminently considerate in tone where censure is necessary. A selection from these, many being discussions full of original matter and suggestive observations, would be an instructive and acceptable contribution to the botanical literature of the century, and a meet tribute to their author's merits and memory.

Dr. Gray's figure and features were familiar in the scientific circles of this country; but for the information of others it may be stated that he was of spare, wiry figure, rather below the average height, his expression was keen and vivacious, and his movements, like his intellect, alert. He was a Foreign Fellow of the Royal and Linnean Societies, a correspondent of the Institute of France, and of the other Continental Academies, a Doctor of Laws of Oxford, Cambridge, and Edinburgh, and had served as President of the American Academy of Arts and Science, of the American Association for the Advancement of Science, and as a Regent of the Smithsonian Institution. Accompanied by Mrs. Gray he spent the summer of 1887 in Europe, chiefly in England, returning to Cambridge in September. In October he went to Washington on the affairs of the Smithsonian Institute. Soon after his return, on the 28th of November, he was struck with paralysis, from which he never rallied, and he died at the end of the following January. It is characteristic of him that his last letter, written in pencil immediately before his seizure to the contributor of these lines, was on the subject of a review for *Silliman's Journal* of Planchon's "Review of the Vines." Dr. Gray married in 1848, Jane, daughter of Judge Charles G. Loring, of Boston, who survives him. He left no family. An excellent medallion likeness of him in bronze was, on his seventy-fifth birthday, presented by his friends to Harvard College, Cambridge, U.S.

J. D. H.

NOTES.

On Tuesday evening a question was asked in the House of Commons, by Mr. Howorth, about the new regulations for the entrance examination at Woolwich. Mr. Howorth inquired whether these regulations were final and permanent, or only temporary. Mr. Stanhope, we regret to say, replied that the regulations are intended to be of permanent application. If that be so, it is the more necessary that a vigorous protest against the scheme should be made by those who have any