

SCIENCE

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CONTENTS:

<i>The Royal Botanical Gardens at Kew:</i> PROFESSOR LUCIEN MARCUS UNDERWOOD.....	65
<i>Absorption in Vertebrate Intestinal Cells:</i> DR. HOWARD CRAWLEY.....	75
<i>Scientific Books:—</i>	
<i>Wiley's Zoological Results:</i> G. H. P. DUHEM's <i>Traité élémentaire de mécanique chimique:</i> PROFESSOR WILDER D. BANCROFT. <i>Guignet and Garnier on la céramique ancienne et moderne:</i> DR. THOMAS WILSON. <i>Robertson's History of Freethought:</i> PROFESSOR R. M. WENLEY.....	80
<i>Scientific Journals and Articles.....</i>	84
<i>Societies and Academies:—</i>	
<i>The Geological Conference and Students' Club of Harvard University:</i> J. M. BOUTWELL.....	85
<i>Discussion and Correspondence:—</i>	
<i>Body Blight of Pear Trees:</i> W. PADDOCK. <i>Formation of Cumulus Clouds over a Fire:</i> S. P. FERGUSSON. <i>A Reply to Mr. Marlatt's Article on Sources of Error in Recent Work on Coccidæ:</i> PROFESSOR T. D. A. COCKERELL. <i>Pot-hole vs. Remolino:</i> F. F. HILDER.....	85
<i>Notes on Inorganic Chemistry:</i> J. L. H.....	88
<i>Current Notes on Meteorology:—</i>	
<i>Foehn Winds; Lightning and the Electricity of the Air; Heavy Rainfall in the Cameroon Mountains; Vertical Temperature Gradient Used on Weather Maps; Recent Publication:</i> R. DE C. WARD	89
<i>Sir William Flower.....</i>	90
<i>Scientific Notes and News.....</i>	91
<i>University and Educational News.....</i>	95

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKEEN CATTELL, Garrison-on-Hudson N. Y.

THE ROYAL BOTANIC GARDENS AT KEW

THE recent establishment of the New York Botanical Garden, following so closely the development of the Missouri Botanical Garden, through the private munificence of Henry Shaw, and the evident tendency in American cities to establish each its own garden as a means of public pleasure and education, leads one to turn to the Old World, where such institutions are no longer a novelty. There is certain to be in the near future in America an awakening of interest in this feature of popular education, and we predict that the next quarter of a century will see them organized as a part of the park system of every city of importance and as a part of the equipment of every university that merits the name and rank.

Passing by the botanical gardens of the Italian cities, some of which are the oldest establishments of the kind in the world, dating back to the fifteenth century, and the less considerable establishments at Berlin and Paris, it is natural to turn to the largest and in many respects the most important of them all, because of its wide reaching influence, coextensive with British colonization itself. Of English botanical gardens those at Oxford and Cambridge, while smaller than Kew, are much older, and yet their influence largely pertains to the university towns and the universities that foster them, while Kew Garden, far from being local or simply national, is in-

tercolonial and international in its character and influence.

Kew Garden is involved in the history of English royalty, for not only is it situated in the heart of historic England, but itself forms a part of that history, being one of that royal series of palaces and parks that from time to time have bordered the Thames from Windsor to Westminster and have made the very region historic. Of this series, Kew with its gardens has been gradually given to the nation by the crown. Westminster ceased to be a royal residence with the bluff King Hal and his tender but well-beloved son; the glories of Richmond Palace as a royal residence ended with the giddy but brilliant Virgin Queen, and today only a vestige remains of Richmond's former greatness; Hampton Court flourished with Queen Anne and William and Mary; Kew's brief period closed with the decadence of the third Georgian reign, when the poor king, bereft of his colonies and finally stricken with disordered mind, was kept here in retirement during the long regency; of all the series, Windsor alone, oldest of all, remains a royal residence.

While the public Kew Garden has been established for less than sixty years, the real existence of Kew as a royal botanic garden dates back to the days of the good Princess Augusta, widow of Frederick, Prince of Wales, son of George the Second, and for a long period prior to this a large number of plants from various parts of the world had been under cultivation, and the whole area now occupied by the garden and arboretum was a private royal park with an abundance of native and cultivated trees; even in the time of Charles the Second the collection of plants was so considerable as to attract much attention, and Kew was regarded as one of the finest gardens in the British Isles. Erasmus Darwin, grandfather of the famous naturalist, sung its praises in his day:

"So sits enthroned in vegetable pride
Imperial Kew, by Thames' glittering side;
Obedient sails from realms unfurrowed bring
For her the unnamed progeny of Spring."

Soon after 1760 the Princess Augusta, mother of George the Third, with the influence of Lord Bute, himself a botanist of some note, called William Aiton, a Scottish gardener botanist, to take charge of the botanic garden. Every botanist is familiar with the *Hortus Kewensis*, which Aiton published in 1789, in which he gave an account of all the 5,500 species of plants growing at Kew, some of which had never before been described; among these were a considerable number of our common American wild flowers and ferns, including some of our common violets and trilliums.* The great number of species of plants described in this work gives some clue to the early growth of Kew Gardens, but within the twenty-five years following Aiton's publication the activity in securing new plants was so great that this number was doubled.

On the accession of the present sovereign, the purpose of opening the gardens to the public was carried into execution, and in 1841, Sir William Hooker, a distinguished botanist from Edinburgh, was called to the post of Director, and the gardens were presented to the nation.

Only a small part of the present area—that immediately surrounding the present Temple of the Sun—formed the original public garden, but gradually more and more passed over to the nation until now some 250 acres are included in the public garden, embracing all the former royal park at Kew except the immediate surroundings of Kew Palace and the wild woods immedi-

* This must not be confused with the earlier *Hortus Kewensis* of Hill, published in 1768, nor the second edition published by Aiton's son in 1813. Hill's catalogue named 488 hardy trees and shrubs, some 200 tender shrubs and over 2,700 herbaceous plants. In 1814 the total number of plants under cultivation exceeded 11,000.

ately about the Queen's cottage. Sir William Hooker died in 1866 and was succeeded by his son, Sir Joseph D. Hooker, also an eminent botanist, who still has his room in the herbarium and at 81 is yet active and enthusiastic in botanical work. He resigned his post as Director in 1885, and was succeeded by Dr. W. T. Thiselton-Dyer, who for some time previously had occupied the position of Assistant Director. It is needless to say to those who have watched the growth and widening influence of Kew in the past few years that much of the present development and much of the system manifest in its management, and, above all, its widening influence, is due to Dr. Dyer's versatility and ability as a Director. For ten years past he has been ably seconded in the management of the garden by Dr. Daniel Morris, whose colonial experience in Ceylon and Jamaica, and wide travel throughout the world, has enabled him to direct wisely the colonial policy of the garden. Many New Yorkers will recall his visit here in 1895, and the managers of our own garden owe much to his kindly advice and suggestions on their plans, rendered after an extended visit to Bronx Park.

Kew Gardens are located on the Surrey side of the Thames, on the line of omnibuses leading from London to Richmond and Hampton Court. The seventh mile post from Hyde Park corner is just beyond the Unicorn Gate. Two railways, besides the Thames steamers and omnibuses, connect it with London, and its appreciation by the people is shown by the great numbers of visitors, ranging from a few thousand to a hundred thousand people in a day, the latter crowd only on bank holidays or other special occasions.

The development of Kew Gardens from the first has been a struggle with adverse conditions. In the first place, the park is a flat meadow land bordering on the

Thames, and all the slight inequalities of surface that now exist in the garden are artificial, having been made from ancient gravel pits or purposely excavated from the soil. There is little variation in the soil itself, which is generally of poor quality, underlain by alluvial deposits of sand and gravel, which permit the rapid loss of water by infiltration. Not a rock occurs on the tract, and the rustic rock garden that is now one of the attractive features of the place was artificially constructed from the remains of an old stone building.

In all the features that pertain to natural location and diversity of structure our own Bronx Park possesses vastly superior advantages for a botanical garden by reason of its bogs, its meadows, its rocks, its wooded knolls, its meandering river, and withal a soil that will support its vegetation with far less care than must be constantly devoted at Kew. In fact, Kew lacks all those natural bits of rusticity that are constantly surprising one in our own garden and which the management has wisely determined to protect and perpetuate.

In the second place, the annual rainfall at Kew is less than at almost any other place in the British Isles—in fact, little above one-sixth of the maximum in the United Kingdom. This condition tends to drouth and necessitates a vast amount of artificial spraying; notwithstanding all this, the drouth of the past two summers made the beautiful lawns look brown and bleak, as though it were November instead of July.

Kew Gardens lie in an upward bend of the River Thames as it curves round from Twickenham Ferry to Mortlake, so that the outline is more or less irregular, though the eastern side is nearly straight, being bounded by the narrow road from Kew Bridge to Richmond. All along this road the gardens are shut in by the characteristic ugly brick wall, much like those that shut out the pub-

lie gaze from more than mere glimpses of the beautiful flower gardens of England and render the abrupt brick fronts of the houses more ugly than ever to one accustomed to anything better in the direction of more tasteful architecture. Here, however, the wall is higher than usual, but, fortunately, lacks the usual European *garçon-de-frieze* of broken bottles and window glass. The southern boundary is adjacent to the pleasure ground and deer park of Richmond.

Recently part of the grounds adjacent to Kew Palace have been sufficiently opened up, so that the palace is clearly seen from the Gardens. This old palace, unpretentious and ugly as it is, has its memories in fact and fancy, and its site has an older history still. Here stood the 'dairie house' which in Elizabethan times was owned by Robert Dudley, and here is where Leicester brought his first wife, the unfortunate Amy Robsart, after his marriage at Richmond Palace. Here, in the present palace, was the home of the good Queen Caroline, and here brave Jeanie Deans was brought into her presence by the noble Argyle to intercede for her unfortunate sister. Here the good queen died in 1737, and here George the Third, still wondering why he lost his colonies, passed his last mournful years in comparative solitude. At the rear of the palace, easily visible from the Thames bank and path, is the venerable linden tree, with its dense foliage, under which the children of George the Third were trained in their rustic out-of-door school, and a little farther up the Thames, on what is called 'Queen Elizabeth's Lawn,' is the old stump of the elm planted by the bloody Mary, still managing to put forth a few leafy branches, though merely a fragment remains of its former greatness. A much younger and smaller elm on the same lawn has a girth of nearly twenty-five feet.

Throughout the grounds at Kew are

magnificent examples of many native and exotic trees; among the many are the noble oriental sycamore just beyond the old orangery; the weird cedars of Lebanon, near the pagoda; and, what are the most interesting, the black locust and the persimmon standing near the Temple of the Sun, the last particularly a much finer specimen than is usually seen in its American haunts. This group contains, perhaps, the oldest trees in the garden, and a tradition asserts that they were among the number transplanted from the garden of the famous Duke of Argyle. Besides these trees, which are not indigenous to Britain, are the groves of English beeches and elms in places surrounded by soil that has not been disturbed for over two hundred years and producing a spring flora unlike that of any portion of England for miles around. Here and there are magnificent couples of lindens or European oaks, often planted on a slightly raised artificial mound, and at one point there is a lonely row of decrepit elms carefully protected in their old age and known as the 'seven sisters'—tradition telling us that they were planted for the seven daughters of King George; only five of them now remain and some of these are badly battered by time.

Across the Thames from the garden, over a wide stretch of greensward toward which one of the delightful vistas of the garden opens, is the old Syon house, an old monastery and nunnery founded by Henry the Fifth in 1415, but closed for the second time by Elizabeth, and presented by her to the Duke of Northumberland, to whose line it still belongs.* A little farther up,

* This old monastery, like many others, has its quaint history, which has been elaborated in book form. One of its peculiarities, due, perhaps, to the fact that it was occupied by both monks and nuns, was the maintenance of silence, which necessitated the formation of a sign language as elaborate as it was peculiar. From its long series of signs we quote one or two samples:

in the old bit of wild woods in the vicinity, is a quaint old thatched cottage of the sixteenth century, which Elizabeth used to visit with her courtiers and which is still carefully preserved as 'the queen's cottage.' It is not surprising to those who are familiar with the inner history of these times that the lane leading to this cottage and formerly separating Kew Gardens from the Richmond deer park bore the name of 'love lane.'

Among the notable features of Kew Gardens that can be well recommended are the long vistas in the arboretum crossing each other at angles and serving to open up distant features of the garden grounds and thus preventing the massing of the vast crowds of visitors, who would otherwise endanger the glass houses and the tender ornamental plants of the more easily accessible portions. In the construction of these vistas the director has happily adopted the practice of trimming up the lower branches of the lines of trees, thus giving a more perfect appearance of distance and proper perspective to the vista. In the purely decorative portions of the grounds, which, by the way, are somewhat excessive for the scientific harmony of the gardens, there are masses of one sort of flowers in large beds, usually of a conspicuous color, which serve an impressive decorative purpose. The usual monotony of the level ground is varied here and there by shallow sunken areas with light terraces, including ornamental beds. The various buildings, conservatories and museums are widely separated from each other, as a further means of scattering the crowds of people who visit them. The two largest conservatories, the palm house and the temperate house, are over a quarter of a

mile apart, and the three museum buildings are at the apices of a triangle whose sides measure 800, 1,100 and 1,500 feet respectively.

The famous flower paintings of the 'North Gallery,' representing the work of the busy but happy life of Marianne North, form a valuable and beautiful adjunct to the collection, as they represent the plants of nearly every flora of the earth exquisitely painted in their native and natural setting, and withal scientifically accurate in their delineation.

The waste steam from the engine house has recently been utilized to warm a small pond in which sub-tropical aquatics appear to be thriving at a latitude where they would otherwise fail to grow in the open, or, at least, fail to produce their blossoms. It surprises one familiar with English climate to see certain species of palms growing out of doors, and the bamboo plantation is one of the instructive features of the garden collection.

Among these praiseworthy features there are others that might be improved upon, and these should be noted. Besides the excess of area where a strictly decorative treatment obtains, there is a stiffness about certain portions, notably the herbaceous ground with its formal rectangular beds and the ugly brick wall that separates it from the rest of the garden. Strikingly in contrast with this, and more striking because of its immediate vicinity, is the rock garden which, though artificial, is really one of the most delightful bits of irregularity in the entire tract. It must in justice be said that some portions of the formality at Kew are inheritances from a royal past. Some of the old conditions seem strange to one of democratic birth; for instance, since a previous visit to Kew, in 1894, the wire fence that used to separate the more recent arboretum from the garden proper has been removed; on one

"Etyng. Pvt thy right thombe with two fore-fyngers joynd to thy mouthe."

"Fysshe. Wagge thy hande displaied selydnynges in manere of a fissh tail."

side of this fence smoking was formerly prohibited, while it was permitted, if not encouraged, on the other side; with the disappearance of the fence has died out the prohibition, for old customs do die even in conservative England.

Another feature lacking at Kew and emphasized by its presence at other places, notably, the gardens at Berlin, is the sharp definition of distinctive floras illustrating the modern principles of ecology. Nowhere could the contrasts of two strange floras be more strikingly shown than in the smaller greenhouse known as the 'succulent house;' here are two peculiar floras magnificently represented, the cactus flora of the Sonoran region of southwest America and the characteristic Euphorbiaceous flora of southern Africa. The geographic contrast of plants closely similar in habit but widely separated in their botanical characters might be most beautifully and forcibly illustrated here, but the opportunity is entirely lost, for the plants are commingled instead of contrasted and only the insignificant labels give to the expert the clue to this marvellous principle of plant distribution, while to the ordinary observer a most effective object lesson is entirely lost. Perhaps it may justly be said that with all their success at colonization, the principles of plant distribution are not so thoroughly grasped at Kew as they have been brought out at the German botanical garden through the skill of Professor Engler and his associates.

The museums, too, at Kew are greatly crowded and one leaves them with confused notions of their significance. This arises: first, from the fact that the buildings are small and two of them are badly broken up into a number of small rooms, and thus are not at all adapted to their present use; secondly, from the enormous mass of material crowded into insufficient space; thirdly, from combining the economic series that at-

tempts to show the legion of plant products useful to man, with the taxonomic series that attempts to show the structural relations of plants to each other; and, finally, from the absence of any modern biological principle governing the arrangement of the collection. Even in the third museum, where the species of woods are illustrated, the collections, because of these features we have noticed, are vastly inferior to the magnificent Jesup collection in the American Museum of Natural History, where the value of rational methods of displaying a collection are added to the intrinsic value of the collection itself. At Kew the arrangement detracts from a collection which is the inferior of our own.

Having thus located Kew Gardens geographically and historically and noted some of its internal features, let us consider some of the results that are accomplished through its agency that we may arrive more happily at the *raison d'être* of the existence of botanical gardens in general.

1. The Kew Gardens represent the best expression of horticultural work in Great Britain. Many of the most noted gardeners in the Dominion, at home and abroad, are men who have been trained at Kew, and a succession of young men and women are continually being trained for this work from year to year. The advantages of such a garden training are evident to young gardeners, and there is always a larger waiting list of applicants than the work required can possibly supply. Kew is recognized as the authoritative center for horticultural work, and, interested as she is in introducing new forms from exotic sources, cannot fail to exert a marked influence on horticulture. Many plants find their way hither for authentic naming, and through the agency of Kew many plants of value for decorative purposes are brought to notice, not only in the British Isles, but throughout the world-wide British colonies.

So large a number of plants are continuously in cultivation at Kew that plant growers from all over the United Kingdom visit Kew for purposes of comparison of plants and methods, so that the Kew authorities are in touch with every plant grower of importance throughout the Queen's dominions.

2. A large and properly named collection of growing plants cannot fail to exert a positive educational influence on the general public. There is an amazing ignorance among all classes regarding the names and relations of trees and shrubs. We know the common animals, even those we see only rarely, but we pass under beautiful trees day after day, many of us, all our lives without recognizing either their names or relations, or noting their marked and positive characters; we know the common birds even, better than the trees in which they build their nests. A large and diversified named collection of trees and shrubs is, therefore, an educational influence of no small value. And this is more especially true when the plants are selected not merely because they present a mass of brilliant color, nor when they are selected for their mere novelty, as in the case of many private collections of note, but when, as at Kew, they are selected from all parts of the world to represent the distinctive vegetation of different regions, and from the entire range of the vegetable kingdom, and are arranged so as to show geographic (ecologic) and biologic relationships, and most especially when they are supplemented by museums illustrating the economic value of plants and their relation to man and his welfare. As we have said before, Kew is particularly hampered from her lack of suitable buildings for her museums. The three buildings occupied for this purpose were none of them originally intended for any such use. One was the orangery erected for the Princess Augusta in 1761, and bear-

ing her monogram, and the other two were residence houses not in the least adapted to their present use as museums. This has necessitated the combination of the systematic (or more properly taxonomic) and the economic series, and has prevented as consecutive and logical an arrangement as would best serve educational ends. The New York Botanical Garden is fortunate in being able to outline its plans untrammelled by existing conditions other than those imposed by nature, and in arranging liberally for its museum under a single roof in a fire-proof building, where its economic and taxonomic series of collections can be displayed, without crowding, on separate floors of the building.

3. The interrelations of Kew with the colonial gardens so widely scattered in both hemispheres and in every zone make possible the broad study of suitable economic plants for cultivation in a particular colony, and, reciprocally, the colonial stations are helpful in enabling the mother garden to know the conditions that exist which will permit the development of certain agricultural industries within their territory. In selecting plants of economic importance for new colonies or in aiding in the renewal of old colonies that have been ruined by neglect; in distinguishing between the varieties of cultivated plants more or less valuable for their useful products; in assisting to prevent the extermination of useful plants that are endangered in their native countries; in assisting to make more productive the enormous colonial development, and in preventing the destruction of forests that if continued would turn fertile provinces into desert places—in all these important factors of English civilization the Kew Gardens serve an important and useful purpose in advice and direction. The development of the cotton and cinchona culture in India, the agricultural development of Ceylon and the extension of the

area of cultivation of tea are all examples that illustrate the direct benefit of Kew to the English colonial system. And this influence is bound to extend still further. Many of the problems have been settled for the Asiatic colonies, and the Australasian region has begun to develop its own botanical centers ; but the vast areas just opening up in the Dark Continent and the problems that will arise in regard to its agricultural development are yet to be worked out. The Anglo-Saxon is the only race that can enter a country, hold it firmly and elevate it in the scale of civilization by making it more productive. France has to face the difficulty of keeping up her own home population, and her colonial development has been comparatively feeble ; the Spanish have nearly blighted every country on which they have laid their hand ; and recent German attempts seem to merit for them the title of an impracticable people ; the Anglo-Saxon blood, English or American, is destined to be the leading colonizing and civilizing spirit throughout the world in the future, as it has been in the past.

4. Aside from the economic features of the garden influence, there are others affecting the development of botany as a pure science that may well be considered. Connected with the garden is the largest herbarium of the world. Here are the types* of all the plants published at Kew from the British colonies ; many others that have encircled the globe in every direction and have touched on every mainland and insular coast ; others still that have been ob-

tained through the purchase or donation of collections of other than British botanists. Besides these there are authentic if not type specimens derived from miscellaneous sources, in many cases vouched for by the author of the species himself and distributed with his own label.

In this way types or authenticated specimens of probably three-fifths or more of the 135,000 known flowering plants and ferns are here represented, and usually a great number of specimens represent the variations and geographic distribution of all except the rare species. More or less authentic specimens exist of most of the remaining two-fifths of the higher plants, so that the Kew herbarium is the consulting herbarium of every country, and its visitors' list for a year will disclose the names of botanists throughout the world. While at Kew during one summer I met botanists from Berlin, St. Petersburg, Brussels, Geneva, Java, Ireland, Trinidad, the Channel Islands, Arizona and Minnesota, all consulting either the growing collection in the garden or the specimens preserved in the herbarium. The other great European collections, notably the ones at Berlin and Paris,* are important and contain many types and must often be consulted for supplementing the types missing at Kew. The same may be said of other less important European collections, ranging from St. Petersburg to Madrid. The Torrey herbarium at Colum-

* By a type is meant botanically the original specimen from which the species was described when it was first made known. This specimen has a particular value, for if any subsequent question arises regarding the species in question it must be settled by reference to this type. Not unfrequently in the case of plants described from imperfect material the type is a much less complete representative of the plant than specimens collected later, but any question of appeal must be to the type itself.

* It was the writer's opportunity, after spending a summer at Kew, to visit, for a short time, the collection at the Jardin des Plantes. In this way the vastness of the Kew collection, as compared with that at Paris, was more forcibly impressed. At Kew the floras of even the French colonies themselves, collected by Frenchmen themselves, were abundantly represented. At Paris the collection was conspicuous by their absence. Even the series of plants representing the labors of French monographers are vastly better represented at Kew than at Paris. The Berlin collection, owing largely to the efforts of Dr. Engler, is much more important, and, in some directions, is rapidly gaining on its British rival.

bia, the Gray herbarium at Harvard and the National herbarium at Washington are any of them far richer in the representation of the plants of the United States; yet, considered from the standpoint of the world's flora, the collection at Kew is practically equal to all others combined in general completeness and diversity of representation.

The herbarium was formerly housed in another of the royal residences at Kew which adjoins Kew Green, and was called the house of the King of Hanover, because it was once occupied as the residence of that prince who succeeded to the throne of Hanover as George the Fifth.

This house for a long period was the sole repository of the great collections and library of the Kew Garden, but within the past few years the present director has expended a small appropriation in erecting a large three-galleried addition, which now contains all the plants above the ferns, but which is very inconvenient because of the lack of concentration on a single floor and the necessary waste of time in passing from books to specimens and *vice versa*. It is the greatest cause for regret among those who appreciate its value to science that the building is not fire-proof. It is a sad comment on the scientific public spirit of England that her government should permit this invaluable collection to remain in any other than a fire-proof building. The loss of this enormous collection would be irreparable, and would alike affect the botanical knowledge of all the great floras of the globe, from Canada to Tasmania and from Iceland to the Straits of Magellan, wherever British colonial activity and scientific exploration have manifested themselves. To leave such a collection in even the remotest peril from destruction by fire is a national disgrace that the good sense of the English government ought to correct without delay.

The Kew herbarium has for years been

under the care of J. G. Baker, well known for his publications on ferns and monocotyledons. Recently he has been succeeded by his able assistant, W. B. Hemsley. George Massee, author of a work on British fungi, is in charge of the lower cryptogams. Besides these the strictly botanical staff consists of six botanists and botanical assistants, a botanical artist, besides some clerical force. The morphological and physiological work is carried on for the Garden under Dr. D. H. Scott, at the Jodrell Laboratory, within the garden enclosure. Besides the regular staff there are other familiar faces at Kew, who may be classed as voluntary workers. These include, besides the former Director, Sir J. D. Hooker, Professor Oliver, the associate and assistant of Bentham; C. B. Clarke, well known for his publications on the botany of India; M. C. Cooke, and others more or less regular.

The publications of Kew have been enormous. The bibliographical list published in 1895 includes over 1,600 titles, varying all the way from a discussion of some useful plant to the flora of a continent, and from an octavo pamphlet to a ponderous folio volume. In 1863 Sir William Hooker projected a series of 'Floras' on a uniform plan in the English language for all the English colonies. This project has been carried on steadily to the present time. Of these the 'Flora Australiensis,' by Bentham, 1863-1878, in seven volumes, and the 'Flora of British India,' by Sir J. D. Hooker, 1875-1894, are the most important that have been completed. At present the force is actively engaged on the 'Flora of Tropical Africa,' probably the most difficult undertaking of all. It is an unfortunate circumstance that while the Germans are actively engaged on a similar work there is simply rivalry instead of cooperation in its elucidation. The colonial rivalry seen in Central Africa at this time between the Germans and the English, as manifested

by rival steamship companies and rival railroads to Lake Nyanza, is likely to be beneficial in opening up to civilization more rapidly larger areas of territory than could otherwise be reached ; but in the scientific publication of the flora of the region rivalry is likely to result in greater harm than good, for a considerable portion of the work of two independent sets of workers is likely to be duplicated. In the matter of building railroads the British are likely to outstrip their rivals, but in the careful and thoughtful working-out of the great problems presented by the flora the more philosophic German is almost sure to make the better showing. The collection at Kew is so extensive that English botanists have too often neglected the opportunity to compare types at other herbaria easily within their reach and have sometimes belittled work that has been accomplished elsewhere ; such self-importance always suffers a decline, and in this the Kew botanists might have learned a lesson from the history of American botany in the last quarter of a century. But there is hope for better things, for one of the Kew botanists during the summer of 1897 made a visit to Berlin to compare the types in that herbarium, the first Kew botanist that has visited the Berlin collection since Bentham's time, thirty years ago. It is to be hoped that this visit will result in opening the eyes of English botanists to the facts recognized everywhere else, that more careful and philosophical floristic work is being accomplished at Berlin even with more scanty materials in the collection. Kew, too, is learning how to introduce into her staff men of university training more familiar with modern ideas of botanical study.

Besides the floras above noted, the most important work issued from Kew is *Genera Plantarum*, by Bentham and Hooker, which for the first time brought together compact Latin descriptions of all the genera of

flowering plants. It was commenced in 1862 and was completed in 1883, only a short time before the death of its veteran author. This work has not only made possible the study of distant floras of the earth and stimulated the botanical exploration of unknown regions, but has laid the foundations on which the more recent as well as the more logical and complete arrangement has been developed under the editorship of Professor Engler, at Berlin, *Die natürlichen Pflanzenfamilien*.

As a supplement to the *Genera Plantarum*, the botanical world is further indebted to Kew for the *Index Kewensis* in four massive quarto volumes, with the names all the flowering plants that had been described up to 1885, with citation of place and date of publication and geographic distribution. This enormous piece of bibliographic work, involving hundreds of thousands of references, was accomplished under B. Dayton Jackson, Secretary of the Linnæan Society, who spent ten years in its completion, the expense being met by funds left for the purpose by Charles Darwin.

Such is Kew with its beautiful lawns, its delightful shade, its historic associations, its immense collection of cultivated plants, and its wonderful activity in the direction of botanical research. Botanical gardens in America can never have the historic associations of their English rivals, but in this country they will be free from most of the conservative inheritances with which the older gardens are hampered. While they can never possess the ancient types of the early explorers, they can and do possess the equally valuable modern types of more recently discovered species, and their collections will in time become just as representative and more complete for the American flora at least than the one at Kew. Besides their philanthropic and educational value, which is chiefly confined to the immediate vicinity in which they are located,

their general usefulness must be world-wide. Their field of investigation even is not to be confined by the artificial limits of the United States, though much remains to be known of our own flora, even that of the more carefully explored eastern region, and especially among the hordes of lower plants that are just beginning to be disclosed. The whole American continent, from Alaska to Cape Horn, with all that immense dark continent of South America, must be the working field of the American botanist. The investigators of the Old World are naturally more concentrated on the study of their own continent, and are generally agreed to leave America to the Americans. The Spanish Americans have accomplished almost nothing in the development of the knowledge of their own floras or the possibilities of their economic vegetal products. The Anglo-Saxon blood in the New World, as in the Old, must originate and direct all exploration and development, and this will form one portion of the work of American botanical gardens. But the scientific study of the flora is only the foundation, the very necessary first step for subsequent work. The study of the active properties of plants, medicinal or otherwise useful to man, deserves close attention, as the recent discovery of numerous important economic products will testify. The question of extending the already prodigious work of transporting the more abundant products of the tropical zone to the region of the highest civilization forms another problem in which the botanical expert is needed to cooperate; then there are important problems of ecology, of plant physiology and of plant diseases, all of which have a direct bearing on the constant and ever-increasing supply of food and shelter for the human race, and these can only be worked out in the presence of such conditions and such extensive collections of plants as a large botanical garden will afford. An extensive garden, with a

director at its head who is primarily a botanist with the widest possible acquaintance with plants and who understands in in what directions botanical science needs to be developed so as to prove most beneficial to the race at large, and with departments of research so endowed that skilled botanical experts in their exclusive specialties can prosecute their investigations free from galling questions of personal support—such a garden is capable of becoming even more influential in democratic America than Kew has become throughout the length and breadth of the Queen's dominions.

LUCIEN MARCUS UNDERWOOD.

ABSORPTION IN VERTEBRATE INTESTINAL CELLS.

THE lining membrane of the vertebrate intestine consists of a single layer of cells. These cells are of two kinds. Designating them according to their form, the accepted nomenclature is Cylinder cells and Goblet cells. Certain authors have, however, adopted a nomenclature based on physiological differences and term them Protoplasm cells and Mucus cells.

The Cylinder or Protoplasm cells are typical epithelial elements. They have the form of five- or six-sided pyramids, the broad end facing the lumen of the intestine and the narrower end resting upon connective tissue (*Tunica propria*). Oppel (*Lehrbuch der Vergl. Mikr. Anat.*) calls the attached end the base and the free end the apex. The apex is characterized by the possession of a striated border, a structure having the appearance of a bunch of cilia. Its true nature is still in doubt. The nucleus is relatively large and situated near the basal end. The cells have no membrane. They are usually several times as numerous as the goblet cells.

The Goblet or Mucus cells have typically a goblet shape, but show great variation in this respect. They are usually described as