Exhibits at the Franco-British exhibition, London, 1908 / Frederick B. Power, PH. D., director of the laboratories.

Contributors

Wellcome Chemical Research Laboratories.
Power, Frederick B. 1853-1927.

Publication/Creation

London, [1908?]

Persistent URL

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THE WELLCOME CHEMICAL RESEARCH LABORATORIES, LONDON

GUIDE AND CATALOGUE WITH A DESCRIPTION
OF THESE LABORATORIES AT
H EXHIBITION, LONDON, 1908

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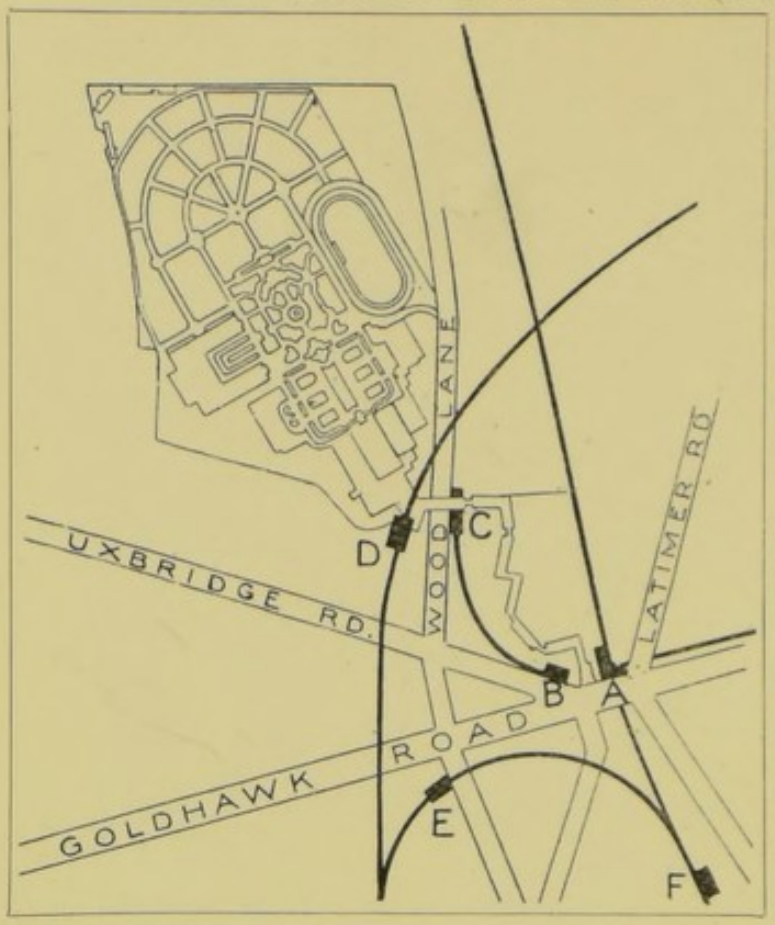
Key Plans to Franco-British Exhibition



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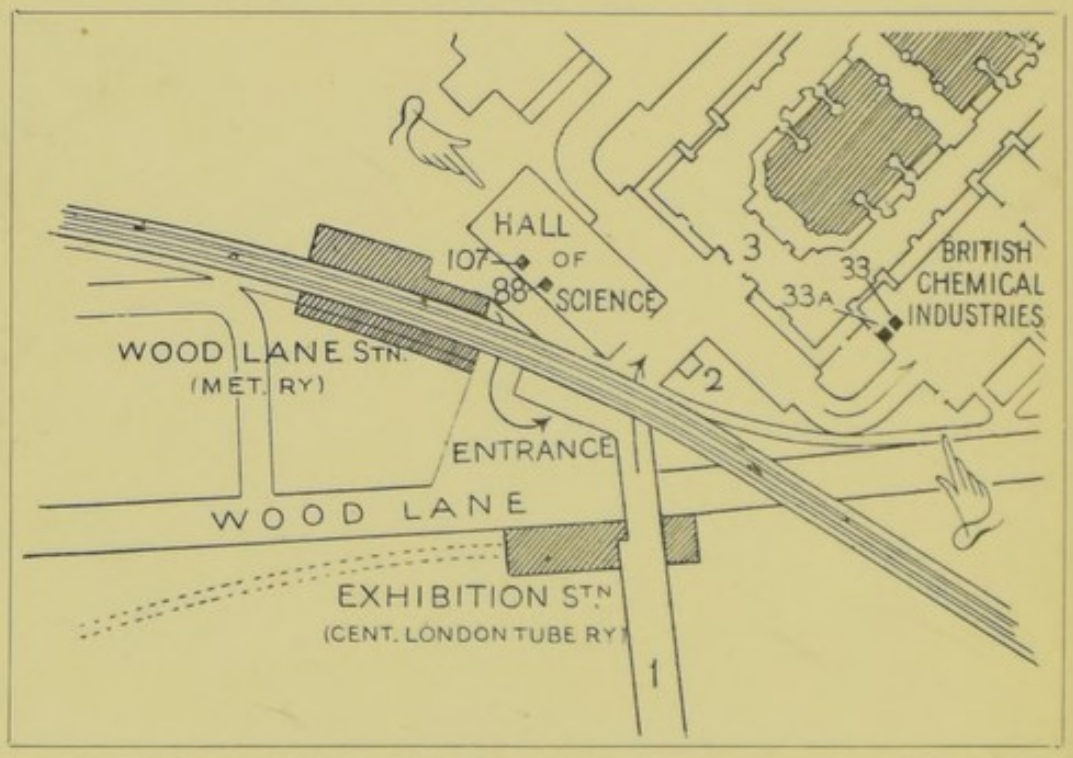


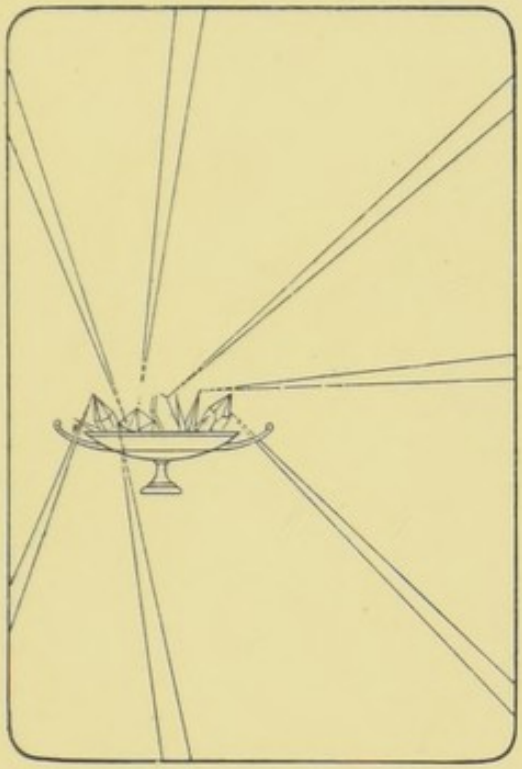
PLAN SHOWING POSITIONS OF THE EXHIBITS IN HALL OF SCIENCE AND SECTION OF BRITISH CHEMICAL INDUSTRIES

33 and **107** Wellcome Chemical Research Laboratories Exhibits

33a and **88** Wellcome Physiological Research Laboratories Exhibits

1 Passage from Uxbridge Road Entrance **2** Post Office

3 Court of Honour.



Sectional Index

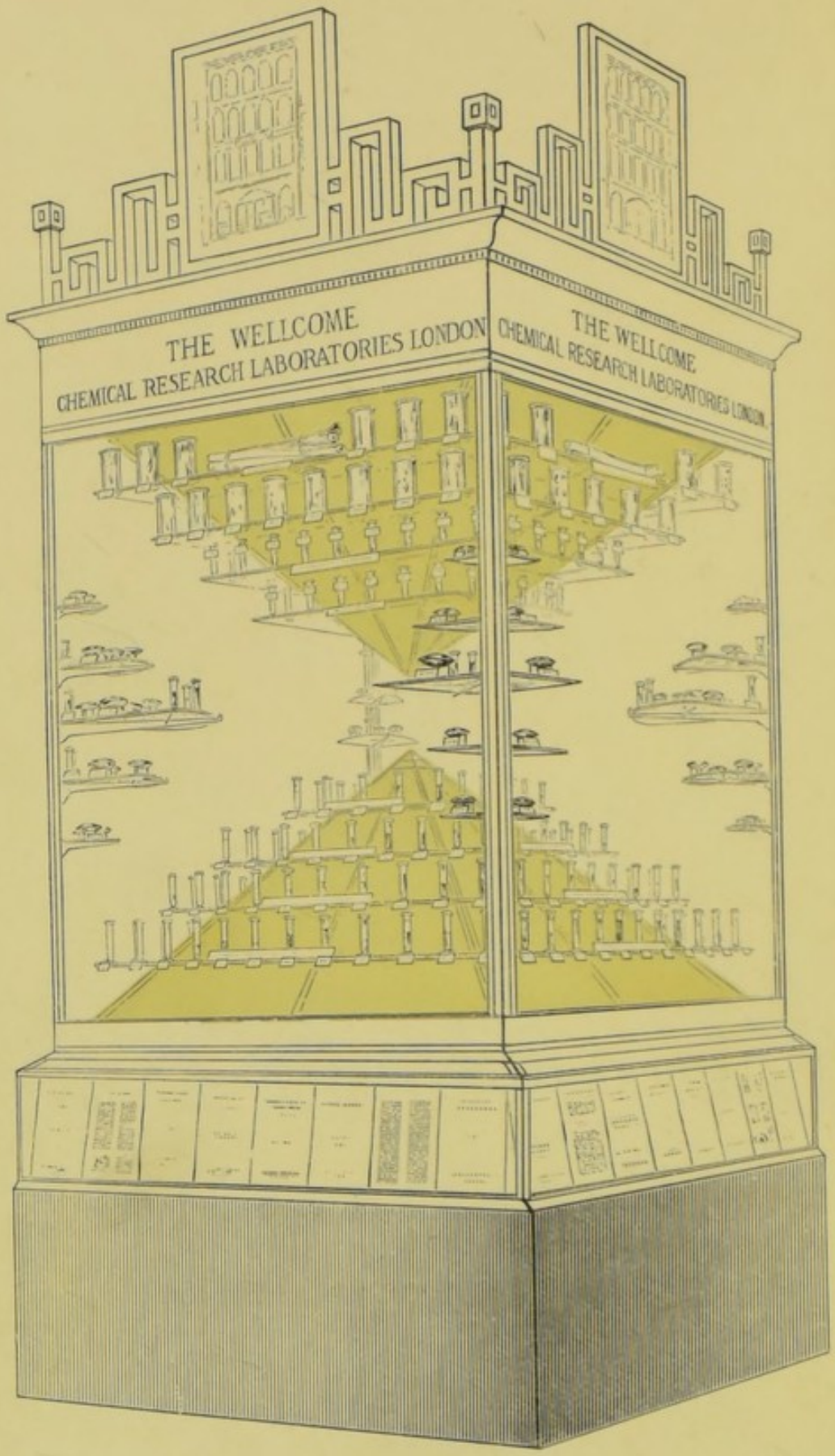


EXHIBIT OF THE
WELLCOME CHEMICAL RESEARCH LABORATORIES
Palace of British Manufactures—Chemical Industries Section
Exhibit No. 33

THE WELLCOME
CHEMICAL RESEARCH LABORATORIES

EXHIBITS

AT THE

FRANCO-BRITISH EXHIBITION

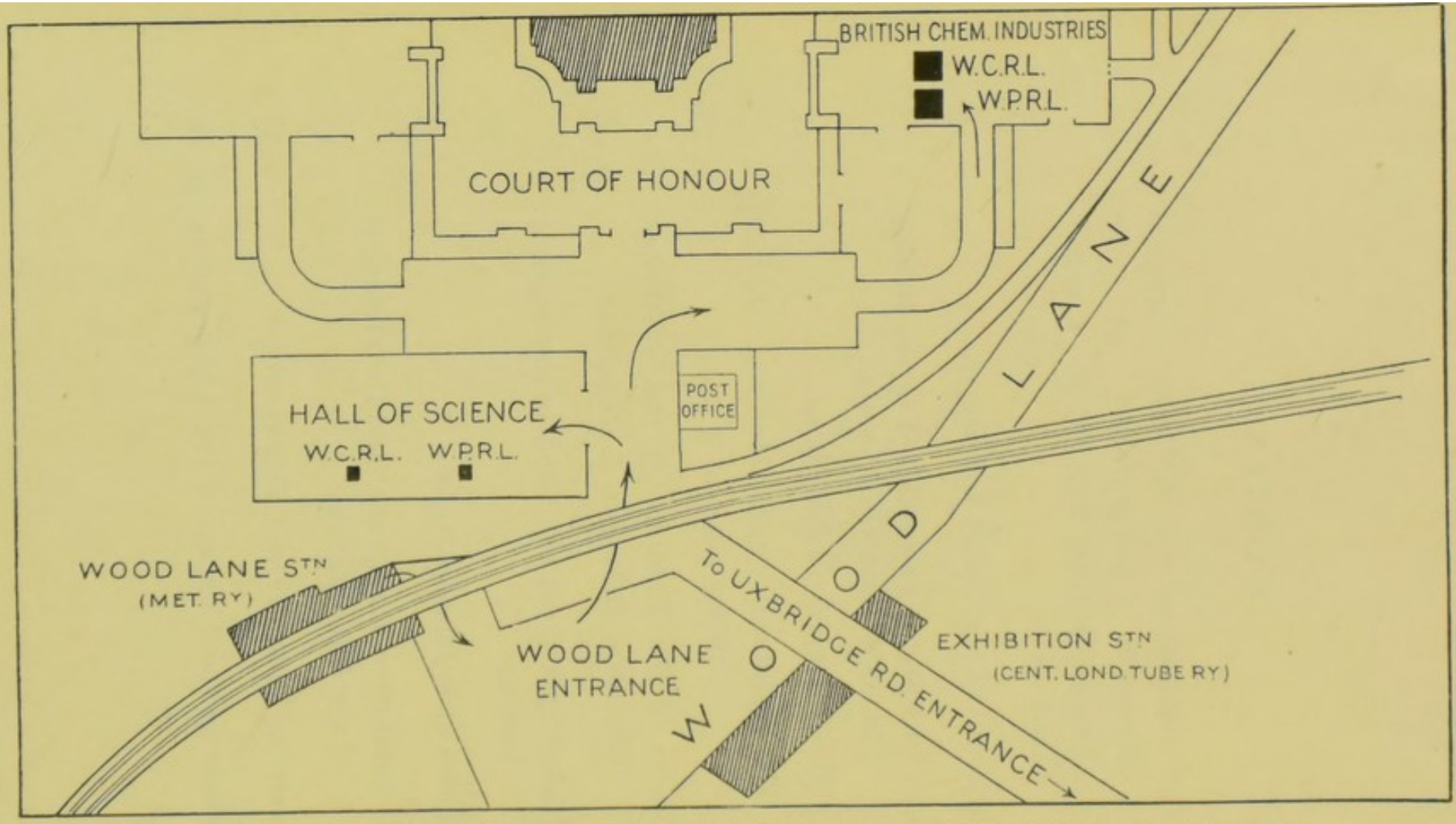
LONDON

1908

FREDERICK B. POWER, PH.D.

Director of the Laboratories

KING STREET, SNOW HILL, LONDON (ENG.)



KEY PLAN OF THE EXHIBITS OF THE WELLCOME RESEARCH LABORATORIES

W.C.R.L.—Exhibits of Wellcome Chemical Research Laboratories

W.P.R.L.—Exhibits of Wellcome Physiological Research Laboratories

EXHIBITS OF
THE WELLCOME CHEMICAL RESEARCH LABORATORIES
AT THE
FRANCO-BRITISH EXHIBITION, LONDON, 1908

A. Exhibit (No. 33) in Chemical Industries Section—Palace of British Manufactures.

B. Exhibit in Science Section — Hall of Science. Table No. 107.

THESE Exhibits are designed to be illustrative of the work accomplished in the Wellcome Chemical Research Laboratories, and in connection therewith it has been deemed of interest to present a concise description of them, in order to indicate the purpose and extent of the scientific researches upon which they are based.

The investigations conducted in these laboratories—founded by Mr. Henry S. Wellcome in 1896, and since then under the direction of Dr. Frederick B. Power—have been of a most varied character and wide range, representing many branches of chemical science. They have comprised, amongst other subjects, the complete chemical examination of a large number of plants or plant products, which, on account of their reputed medicinal value or other properties, have been considered of special interest. The material thus employed, often specially collected for the purpose, includes not only many well-known drugs which are indigenous to Europe and North America, but also products from distant lands, such

as Africa, India, Australia and the Fiji Islands. This material has yielded a great variety of chemical compounds of considerable interest, while from such products as the essential and fatty oils several new substances have likewise been isolated. In connection with the isolation and characterisation of the more important of these organic compounds, considerable time has been devoted to a study of their constitution. In the domain of synthetic chemistry a number of new organic compounds have been produced, and, among the inorganic salts, several have been brought into new forms of combination, whereby through greater uniformity of composition, permanency, or solubility, they have been rendered more suitable for medicinal use.

The detailed results of these investigations have been published for the most part in various scientific periodicals and transactions, such as the *Journal of the Chemical Society* (London); the *Journal of the American Chemical Society*; the *Journal of the Society of Chemical Industry*; the *American Journal of Pharmacy*; the *Archiv der Pharmacie*; the *Year-Book of Pharmacy*; and the *Proceedings of the American Pharmaceutical Association*. These published papers, of which a list is appended, are distributed from time to time to those who are thought to be interested in the subjects of which they treat, and to such institutions or libraries as desire to preserve a record of them.

In the following pages an attempt has been made briefly to outline the more important results of the

work thus far accomplished. It may be noted, however, that in these Exhibits it has not been possible, from considerations of space, to include all the products of the various investigations, and the specimens have therefore been restricted to a selected number.

A. Exhibit in Chemical Industries Section.

I. Chemical Investigations

The Alkaloids of Jaborandi Leaves

An extended and exhaustive research was undertaken for the purpose of elucidating the nature of the alkaloids of Jaborandi leaves, with special reference to the chemical constitution of pilocarpine and *iso*-pilocarpine. This investigation, which occupied several years, and required the use of large quantities of very valuable material, was finally brought to a successful issue by establishing for the first time the true constitution of these alkaloids (*Journ. Chem. Soc.*, 1900, **77**, pp. 473–498; 851–860; 1901, **79**, pp. 580–602; 1331–1346; 1903, **83**, pp. 438–464; 1905, **87**, pp. 794–798; also *Year-Book of Pharmacy*, 1899, pp. 435–441, and *British Medical Journal*, 1900, pp. 1074–1077).

Glyoxaline and Pyrazole Derivatives

In connection with the preceding researches on pilocarpine, some new substances, glyoxaline and pyrazole derivatives, were synthetically prepared, and their properties carefully determined (*Journ. Chem. Soc.*, 1903, **83**, pp. 464–470).

Researches on Morphine

In order to ascertain the relationship existing between the physiological action and the chemical constitution of

morphine, a number of new derivatives of this alkaloid were prepared and physiologically tested, and some new products having a chemical structure analogous to that of morphine were also prepared by electro-synthesis. The latter compounds gave rise to considerations involving some interesting points in chemical dynamics (*Journ. Chem. Soc.*, 1900, **77**, pp. 1024–1039; 1901, **79**, pp. 563–580; 1903, **83**, pp. 750–763).

The Constitution of Epinephrine

and

The Synthesis of Substances allied to Epinephrine

The active principle of the supra-renal gland has been variously designated as "epinephrin," "adrenalin," and "suprarenin." An investigation of this important medicinal substance was undertaken for the purpose of determining its constitution, and subsequently some compounds allied to epinephrine were prepared by synthetical methods and subjected to physiological tests (*Journ. Chem. Soc.*, 1904, **85**, pp. 192–1971; 905, **87**, pp. 967–974).

Synthetic Tropeines

The preparation of a number of new tropeines was undertaken in order to determine some points of interest relating to the connection between chemical constitution and physiological action. It had been observed, for example, in the case of pilocarpine, that in contact with aqueous alkalies its characteristic physiological action became very much diminished, and this appeared to be due to a change from the lactone structure to that of the corresponding hydroxy-acid. For the further investigation of this change several new tropeines were prepared and physiologically tested. The general results of the enquiry led to the following conclusions: (1) That the peculiar difference in physiological action between a lactone and its corresponding

hydroxy-acid, as exemplified by pilocarpine and pilocarpic acid, also occurs in the case of a tropeine having a haptophore group similar to that in pilocarpine, namely, terebyltropeine, and also in the case of phthalide-carboxylic tropeine. (2) That Ladenburg's generalisation, so far as it refers to the necessity for a mydriatic tropeine to contain a benzene nucleus, does not strictly hold, since terebyltropeine possesses a distinct mydriatic action. It would appear, however, that the conditions most favourable for the development of the mydriatic action in a tropeine are those stated by Ladenburg, namely, that the acyl group should contain a benzene nucleus and an aliphatic hydroxyl in the side chain having the carboxyl group (*Journ. Chem. Soc.*, 1906, **89**, pp. 357–365).

Composition of Berberine Phosphate

As considerable discrepancy had existed in chemical literature respecting the formula for berberine phosphate, in the course of some more extended work on berberine salts the true composition of the phosphate was determined (*Year-Book of Pharmacy*, 1900, pp. 507–513).

A New Type of Gold Salts

Some observations made during the course of an analysis led to the discovery of a new type of gold salts of the alkaloids, of which those of atropine, hyoscyamine and hyoscine, were prepared and characterised (*Journ. Chem. Soc.*, 1897, **71**, pp. 679–682).

Essential Oil from the Fruit of Pittosporum undulatum, *Vent.*

The tree, from the fruit of which the essential oil of *Pittosporum* was distilled, is indigenous to South-Eastern Australia, where it is known by the popular names of "Native Laurel" and "Mock Orange." The

oil, which possesses a pleasant orange-like odour, was found to contain a large proportion of limonene, besides smaller amounts of pinene and various esters, but its most interesting constituent is a new, optically-inactive *sesquiterpene* (*Journ. Chem. Soc.*, 1906, **89**, pp. 1083-1092).

Essential Oil from the Leaves of Umbellularia Californica, *Nutt.*

The tree, from the leaves of which this essential oil is distilled, is indigenous to California. It is an evergreen, and is known by various popular names, such as "California Laurel," "Mountain Laurel," "California Bay-tree," "Spice-tree," "Pepper-wood," etc. The essential oil is an aromatic liquid, possessing a peculiar pungency. The latter property is due to the presence of a ketone, $C_{10}H_{14}O$, which was first isolated and characterised in these laboratories, and has been designated *umbellulone*. A number of derivatives of umbellulone have been prepared, and special study has been devoted to its constitution, which has also been definitely established (*Journ. Chem. Soc.*, 1904, **85**, pp. 629-646; 1906, **89**, pp. 1104-1119; 1907, **91**, pp. 271-274; 1908, **93**, pp. 252-260).

Essential Oil from the Rhizome of Asarum Canadense, *Linné*

The plant, from the rhizome of which this essential oil is distilled, is indigenous to North America, where it is known by the popular names of "Wild Ginger" or "Canada Snake-root." The essential oil is a very aromatic liquid, and is largely used in perfumery. The constituents of the oil have been thoroughly investigated, and amongst these may be noted the alcohols, linalool, borneol, terpineol, and geraniol, to which, or their esters, the peculiar fragrance of the oil is due (*Journ. Chem. Soc.*, 1902, **81**, pp. 59-73).

Essential Oil of Algerian Rue

The constituents of this oil were thoroughly investigated. The larger proportion of the oil was found to consist of methyl *n*-heptyl ketone and methyl *n*-nonyl ketone, which were present in about equal amounts, and these were accompanied by relatively small amounts of the corresponding carbinols. In connection with this investigation, a new, synthetic ketone, methyl β-methylhexyl ketone, was prepared and characterised (*Journ. Chem. Soc.*, 1902, **81**, pp. 1585–1595).

Essential Oil of Hedeoma pulegioides, *Persoon*

The plant yielding this essential oil is indigenous to North America, where it is commonly known as "American Pennyroyal." The oil, which possesses a highly aromatic, mint-like odour, is used medicinally. It contains a considerable proportion of pulegone, and the investigation conducted in these laboratories has led to the identification, among other compounds, of *l*-menthone, *d*-*iso*menthone, and methyl*cyclo*hexanone as constituents of the oil. The two last-mentioned ketones are of particular interest, inasmuch as it appears to have been the first instance in which their occurrence in Nature has been observed (*Journ. Chem. Soc.*, 1907, **91**, pp. 875–887).

Essential Oil of Nutmeg

This essential oil has been thoroughly investigated, and has been shown to be of very complex composition. Although consisting largely of the terpenes pinene, camphene, and dipentene, it also contains, among other substances, the alcohols linalool, borneol, terpineol, and geraniol, or their esters, together with eugenol, *iso*-eugenol, safrole, and myristicin. It was shown that the portion of the oil which had hitherto been designated "myristicol" is a mixture of alcohols, consisting chiefly of terpineol (*Journ. Chem. Soc.*, 1907, **91**, pp. 2037–2058).

Expressed Oil of Nutmeg

In connection with a complete study of the constituents of nutmeg, the expressed oil, commonly known as "Nutmeg Butter," has also been subjected to a careful examination. In order to be assured of the genuineness of the material employed, the oil was specially expressed for the purpose. Although it was previously known that this product contained varying amounts of essential oil, and that the fatty portion consists to a considerable extent of trimyristin, the nature of the other constituents had not been definitely ascertained. Some of the substances that have quite recently been obtained from this fat are therefore included in these Exhibits.

The Seeds of Taraktogenos Kurzii, *King*

(Chaulmoogra Seeds)

The plant from which these seeds are obtained is a native of Burma. The seeds, on expression, yield a fatty oil, commonly known as "Chaulmoogra Oil," which is largely used, both internally and externally, in the treatment of leprosy, as also in various other skin diseases. The investigation of this oil has afforded results of exceptional interest, inasmuch as it has been found to consist, to a large extent, of the glyceryl esters of optically active acids of an entirely new type. These acids are represented by the general formula $C_nH_{2n-4}O_2$, and have a cyclic structure. The acid present in the largest proportion possesses the formula $C_{18}H_{32}O_2$ (m.p. 68°), and has been designated *chaulmoogric acid* whilst a lower homologue, $C_{16}H_{28}O_2$ (m. p. 60°), has been termed *hydnocarpic acid*, on account of having first been isolated from a *Hydnocarpus* oil. Both of these acids are beautifully crystalline substances, from which a number of derivatives have been prepared, and their constitution has also been definitely established (*Journ. Chem. Soc.*, 1904, **85**, pp. 838–861; 1907, **91**, pp. 557–578).

The Seeds of Hydnocarpus Wightiana, *Blume*, and of Hydnocarpus anthelmintica, *Pierre* ("Lukrabo" Seeds)

Hydnocarpus Wightiana, Blume, is a tree indigenous to the Western Peninsula of India, whereas *Hydnocarpus anthelmintica*, Pierre, is a native of Siam. The seeds of the last-named species are exported to China under the name of "Lukrabo," and are there known as "Ta-fung-tsze." The fatty oils obtained from the seeds of these two plants have long been used in Western India and in China, respectively, for the same medicinal purposes for which chaulmoogra oil is employed. Both of these oils have been subjected to a complete investigation, the results of which have shown them to resemble chaulmoogra oil very closely, both in their physical characters and their chemical composition. Like the true chaulmoogra oil, they consist to a large extent of the glyceryl esters of chaulmoogric and hydnocarpic acids (*Journ. Chem. Soc.*, 1905, **87**, pp. 884–896).

The Seeds of Gynocardia odorata, *R. Br.*

Gynocardia odorata, R.Br., is a native of Sikkim Assam, and Chittagong in Bengal. The seeds of this plant were, until a few years since, supposed to be the source of chaulmoogra oil, and the latter was therefore frequently designated "Gynocardia Oil." It was shown, however, by botanical investigations, that the true chaulmoogra oil, as above indicated, is obtained from the seeds of a quite distinct plant, namely *Taraktogenos Kurzii*, King. Complete confirmation of this fact has been afforded by an examination of the expressed oil from genuine *Gynocardia* seeds. Chaulmoogra oil at the ordinary temperatures is a solid, whereas gynocardia oil is a liquid. The latter oil is, moreover, optically inactive, and contains none of the members of the

chaulmoogric acid series. *Gynocardia* seeds were found to contain, besides the fatty oil, a new, crystalline, cyanogenetic glucoside, $C_{13}H_{19}O_9N$, which has been designated *gynocardin*, and an enzyme, termed *gynocardase* (*Journ. Chem. Soc.*, 1905, **87**, pp. 349–357 and 896-900).

Olive Leaves and Olive Bark

The leaves of the olive tree (*Olea Europæa*, Linné) were employed many years ago as a remedy in intermittent fever, and quite recently attention has again been directed to their therapeutic value as a tonic and febrifuge. Both the leaves and the bark of the olive tree have therefore been subjected to a complete chemical examination, which has resulted in the isolation of a large number of new and interesting substances, some of which are included in these Exhibits.

Eriodictyon Californicum (*Hooker et Arnott*), *Greene*

("Yerba Santa")

This plant, as its name indicates, is a native of California. The leaves are used medicinally, and are recognised by the Pharmacopœia of the United States. A recent chemical examination of the leaves, conducted in these laboratories, has shown them to contain several new and interesting substances. Among these there are two crystalline compounds of a phenolic nature which may specially be noted, namely, *eriodictyol*, $C_{15}H_{12}O_6$, and *homo-eriodictyol*, $C_{16}H_{14}O_6$, (*Proc. Amer. Pharm. Assoc.*, 1906, **54**, pp. 352–369). Homo-eriodictyol has been made the subject of a special investigation with reference to its constitution, which has definitely been established (*Journ. Chem. Soc.*, 1907, **91**, pp. 887–896; *Proc. Chem. Soc.*, 1907, p. 243).

MORINDA LONGIFLORA, *G. Don*
("Ojuologbo")

Morinda longiflora, G. Don, is a West African plant, which is stated to be used as a medicine by nearly all the tribes of that region. Both the root and the leaves of the plant have been chemically examined, and from them, amongst other substances, a hydroxymethoxymethylanthraquinone, $C_{16}H_{12}O_4$, was isolated, whilst from the root a monomethyl ether of alizarin $C_{15}H_{10}O_4$, was also obtained. The most interesting constituent of the leaves was found to be a new crystalline alcohol, $C_{38}H_{61}O_3 \cdot OH, H_2O$, which has been termed *morindanol* (*Journ. Chem. Soc.*, 1907, **91**, pp. 1907-1918).

AETHUSA CYNAPIUM, *Linné*
("Fool's Parsley")

Although many cases of poisoning have been attributed to this plant, which is a common garden weed, the observations regarding its properties were very conflicting. In order to ascertain the nature of its constituents a complete investigation was undertaken, and this was conducted with material which had been carefully identified botanically and was known to be free from any admixture. Amongst other substances, a relatively small amount of *d*-mannitol was isolated, but the most interesting constituent of the plant was found to be a volatile alkaloid which resembled coniine in its physical and chemical characters (*Journ. Amer. Chem. Soc.*, 1905, **27**, pp. 1461-1476).

GRINDELIA CAMPORUM, *Greene*

This species of *Grindelia* is a native of California, where it is known as the common "gum-plant." *Grindelia* is used medicinally, and is recognised by the Pharmacopœia of the United States, although defined by this authority as "the dried leaves and flowering tops of *Grindelia robusta*, Nuttall, or of *G. squarrosa* (Pursh), Dunal."

A very complete chemical examination has been made of the plant which was botanically identified as *Grindelia camporum*, Greene. This resulted in the isolation of a number of crystalline substances, but the chief constituents of the plant are amorphous resins, together with a complex mixture of liquid acids and esters, the latter being presumably glycerides. The acids are, for the most part, optically active, unsaturated, cyclic compounds (*Proc. Amer. Pharm. Assoc.*, 1905, **53**, pp. 192–200, and 1907, **55**, pp. 337–344).

Gymnema sylvestre, *R. Br.*

This plant, which belongs to the family of *Asclepiadaceæ*, is indigenous to Banda and the Deccan Peninsula. Its leaves, when chewed, possess the peculiar property of rendering imperceptible the sweet taste of sugar or other saccharine substances, and also, but in a less marked degree, the taste of many bitter substances. This property is due to a substance, or mixture of substances, which has been designated "gymnemic acid." In the course of an investigation of these leaves a *lævorotatory stereoisomeride of quercitol* was isolated (*Journ. Chem. Soc.*, 1904, **85**, pp. 624–629, and *Year-Book of Pharmacy*, 1904, pp. 526–541).

Ipomœa purpurea, *Roth*

("Common Morning Glory")

Ipomœa purpurea, Roth, a plant belonging to the family of *Convolvulaceæ*, is indigenous to the tropical regions of both hemispheres, and is largely cultivated in temperate climates. The material employed for investigation consisted, for the most part, of the ærial stems of the plant, and was obtained from South Africa. In the latter country the stems and roots are used by the natives as an aperient medicine, and are believed to be as valuable for this purpose as Jalap. The active

constituent of the drug is a resin, which has been thoroughly investigated, and shown to be a very complex mixture. Among the numerous substances obtained from the crude resin there may specially be noted a new, crystalline, dihydroxymonocarboxylic acid $C_{13}H_{25}(OH_2)$, CO_2H (m.p. 100-101°), which has been designated *ipurolic acid*. Specimens of this acid and some of its derivatives, together with other products from the drug, are included in the Exhibits.

The Fruits of Brucea Sumatrana, *Roxb.* ("Kô-sam") and of Brucea antidysenterica, *Lam.*

The fruits of *Brucea Sumatrana*, Roxb., popularly known as "Kô-sam Seeds," were obtained from the East Indies, where they are reputed to be a valuable remedy in the treatment of tropical dysentery. The fruits and other parts of the plant of *Brucea antidysenterica*, Lam., are similarly employed in Abyssinia. Both the fruit and the bark of these two species of *Brucea* have been carefully examined. They contain, amongst other constituents, bitter principles, which could only be obtained in an amorphous form, and it was shown that certain statements by previous investigators, regarding the character of the active principles, were erroneous (*Year-Book of Pharmacy*, 1903, pp. 503-522, and 1907, pp. 477 492).

Cascara Sagrada

Cascara Sagrada is the popular Spanish name of a bark which is recognised by the British, United States, and other Pharmacopœias as the dried bark of *Rhamnus Purshianus*, DC. The tree which affords it is indigenous to the north-western parts of North America. A very complete chemical examination has been made of this bark, which was specially collected for the purpose under the supervision of a competent botanist. In the course of the investigation numerous discrepancies of statement in the literature of the subject were critically

considered, with the endeavour to afford a correct presentation of the facts respecting the constituents of this valuable medicinal agent (*Proc. Amer. Pharm. Assoc.*, 1904, **52**, pp. 288–313).

Micromeria Chamissonis (*Benth.*), *Greene*
("Yerba Buena")

This labiate plant is a perennial, trailing or creeping, sweet-scented herb, which is indigenous to the Pacific coast of the United States, and is used to some extent medicinally. Its complete chemical investigation has disclosed the presence, amongst other constituents, of three new, crystalline compounds, namely, *xanthomicrol*, $C_{15}H_{10}O_4 \cdot (OH)_2$ (m.p. 225°), *micromerol*, $C_{33}H_{51}O_3 \cdot (OH)$, $2H_2O$ (m.p. 277°), and *micromeritol*, $C_{30}H_{44}O_2 \cdot (OH)_2$, $2H_2O$ (m.p. 294–296°). The first of these compounds is phenolic in character, whereas the latter two represent monohydric and dihydric alcohols respectively (*Journ. Amer. Chem. Soc.*, 1908, **30**, pp. 251–265).

Lippia scaberrima, *Sonder*
("Beukess Boss")

This is an aromatic, South African plant, belonging to the family of *Verbenaceæ*, and is reputed to possess remarkable hæmostatic properties. The odour of the plant is due to an aromatic essential oil. The material employed for a chemical investigation consisted of the air-dried stems and leaves. Amongst the substances isolated, there may be mentioned a new, crystalline alcohol, $C_{25}H_{35}O_3 \cdot OH$ (m.p. 300–308°), which has been designated *lippianol* (*Archiv der Pharm.*, 1907, **245**, pp. 337–350, and *Amer. Journ. Pharm.*, 1907, **79**, pp. 449–462).

Derris uliginosa, *Benth.*

The stem of this species of *Derris* is used in the Far East as a fish poison. The material employed for its investigation was obtained from the Fiji Islands. It

was ascertained that the poisonous property resides in a resin, which, together with other constituents of the drug, was chemically examined (*Proc. Amer. Pharm. Assoc.*, 1902, **50**, pp. 296–321).

Robinia Pseud-acacia, *Linné*
("Common Locust" or "False Acacia")

The bark of this well-known tree possesses highly poisonous properties. These are due to the presence of a protein, which is soluble in water, and has been designated *robin*. Its characters have been quite completely described (*Pharm. Rundschau*, N.Y., 1890, **8**, pp. 29–38, and *Year-Book of Pharmacy*, 1901, pp. 349–372).

Chailletia toxicaria, *Don*

This plant is a native of Sierra Leone, and, as indicated by its name, possesses poisonous properties. The fruit is largely used in West Africa for the destruction of rats and other animals, and also for criminal purposes. It has been examined both with regard to the chemical character of its constituents and their physiological action (*Journ. Amer. Chem. Soc.*, 1906, **28**, pp. 1170–1183).

Comparative Examination of Willow and Poplar Barks

The examination of a specimen of willow bark which was known in commerce as "Black Willow," led to the discovery of a new glucoside, $C_{13}H_{16}O_7$ (m.p. 195°), which, with reference to its origin, was designated *salinigrin*. This was shown to be the glucoside of metahydroxybenzaldehyde (*Journ. Chem. Soc.*, 1900, **77**, pp. 707–712).

By the subsequent examination of a large number of different species of American and British willows from authentic sources, it was ascertained that the particular species yielding salinigrin is *Salix discolor*, Muhl. At the same time, some very interesting variations were

observed respecting the amount of salicin contained in these barks at different seasons of the year, and in trees of different sex (*Year-Book of Pharmacy*, 1902, pp. 483-490.)

Anthraquinone Derivatives

The investigation of certain anthraquinone derivatives occurring in Nature has included an examination of commercial chrysarobin, which, for many years, was supposed to be chrysophanic acid. In this connection the constitution of chrysophanic acid and emodin, and that of barbaloin, have been made the subjects of special study (*Journ. Chem. Soc.*, 1902, **81**, pp. 1575–1585; 1903, **83**, pp. 1327–1334; 1905, **87**, pp. 878–884).

Benzoxy-Olefines

The investigation of the constituents of an essential oil of Algerian Rue, which has already been noticed, led to a special study of the interaction of ketones and aldehydes with acid chlorides. This was shown to result in the formation of a class of substances known as benzoxy-olefines, and one of the particularly interesting products obtained was the benzoate of the enolic modification of camphor (*Journ. Chem. Soc.*, 1903, **83**, pp. 145-154).

So-called Iodo-tannin Compounds and Some New Derivatives of Gallic Acid

For many years a class of preparations has been used medicinally which have been regarded as actual chemical compounds of iodine and tannin, and somewhat extended observations have been recorded, especially in pharmaceutical literature, which were supposed to confirm this view. The subject was, therefore, fully investigated in these laboratories, and it was proved that the action of iodine upon tannic acid does not result in the formation of any compound of the latter substance containing this element (*Year-Book of Pharmacy*, 1901, pp. 466-476). The subsequent endeavour to prepare a definite compound of iodine

and gallic acid, although unsuccessful, led to the production of a number of new derivatives of the latter substance (*Journ. Chem. Soc.*, 1902, **81**, pp. 43–48).

Phenylic Salts of Camphoric Acid

A general method for the preparation of acid phenylic salts of dibasic acids has been developed, and a number of such new compounds adapted for medicinal use were prepared, amongst which may be mentioned guaiacol camphorate and creosote camphorate (*Journ. Chem. Soc.*, 1899, **75**, pp. 661–669).

In direct connection with this investigation a method was devised for the assay of commercial phenols (*Journ. Soc. Chem. Ind.*, 1899, **18**, pp. 553-556).

The Official Hypophosphites

The chemical characters of these salts were definitely defined, and a reliable method devised for the determination of their purity (*Year-Book of Pharmacy*, 1898, pp. 409–423).

Salts of Natural and Synthetical Glycerylphosphoric Acids

An investigation was undertaken for the purpose of determining the character and composition of some of the more important salts of glycerylphosphoric acid, when prepared by definite methods. In the course of this work it was found desirable to consider the relationship existing between the natural and synthetical glycerylphosphoric acids, and the determination of their constitution was therefore made the subject of special study (*Journ. Chem. Soc.*, 1905, **87**, pp. 249-257; 1906, **89**, pp. 1749-1758).

Composition and Determination of Cerium Oxalate

The unsatisfactory description and tests of Cerium Oxalate, as recorded in the British Pharmacopœia, suggested an investigation of the character of this

medicinal chemical. The methods for the separation of cerium from its associate elements were critically compared, and on the basis of these experiments a plan was devised for the quantitative determination of the amount of pure cerium oxalate in the commercial products. The formula of pure cerium oxalate, with reference to the amount of combined water, was also definitely established as $Ce_2(C_2O_4)_3,10H_2O$ (*Journ. Soc. Chem. Ind.*, 1900, **19**, pp. 636–642).

New Preparations of Manganese, Iron and Bismuth

The desirability of rendering manganese available for medicinal use in a soluble and easily assimilable form, led to some experiments resulting in the production of a *Soluble Manganese Citrate* and a compound of the latter with iron, as also a *Soluble Iron and Manganese Phosphate*. These were all obtained in the form of brilliant scales (*Year-Book of Pharmacy*, 1901, pp. 458–465).

Iron Arsenate, in the form recognised by the British and some other national Pharmacopœias, being a compound insoluble in water, and of extremely variable composition, it was deemed desirable to present this important medicinal agent in a more satisfactory form. A *Soluble Iron Arsenate* has therefore been produced, which is in the form of handsome scales, and contains a definite amount of arsenic.

Some new preparations of Bismuth have also been formed which are specially adapted for medicinal use. These comprise: (1) *Soluble Bismuth Citrate*, which differs from the ordinary bismuth and ammonium citrate by its greater stability and the property of dissolving readily and completely in water, yielding a bright solution; (2) *Bismuth and Lithium Citrate*, a handsome scaled salt, readily soluble in water; and (3) *Bismuth and Iron Citrate*, which contains the respective elements in definite proportions, and in a readily soluble form.

II. BOTANICAL AND PHARMACOGNOSTICAL INVESTIGATIONS

In the department of botany and pharmacognosy several very complete investigations have been conducted, some of which were supplementary to the previously mentioned chemical examination of the respective plants. Thus the anatomical characters of strophanthus seeds, robinia bark, and derris have been carefully studied, and the descriptive details of this work were elucidated by a number of original drawings (*Year-Book of Pharmacy*, 1900, pp. 366–393; *Pharm. Journ.*, 1901, **66**, pp. 518–521; *Year-Book of Pharmacy*, 1901, pp. 372–382; *Proc. Amer. Pharm. Assoc.*, 1902, **50**, pp. 321–331). An extended research on the comparative anatomy of the barks of the *Salicaceæ* has also been undertaken, and the first part of this work, treating of the poplars, has been published (*Year-Book of Pharmacy*, 1903, pp. 442–479).

In connection with the previously mentioned chemical examination of *Grindelia*, a question arose respecting the botanical identification of the particular species employed. This led to a thorough study of the characters of some Californian species of *Grindelia*, whereby it was conclusively proved that the material employed for the above-mentioned chemical investigation consisted, as had been indicated, of *Grindelia camporum*, Greene. It was also shown that the *Grindelia* at present found in commerce is, for the most part, derived from this botanical source (*Proc. Amer. Pharm. Assoc.*, 1906, **54**, pp. 370–374).

A recent contribution from this department which merits particular notice is a monograph entitled:

London Botanic Gardens

This first appeared as a serial publication in the *American Journal of Pharmacy*, beginning in October, 1905, and continuing through successive numbers of this journal until its completion in August, 1906. The

collected papers were subsequently issued, in a pamphlet of 100 pages, as No. 62 of the publications of these laboratories. In the description of the London Botanic Gardens special pains were taken to ensure historical accuracy, while their more prominent features and equipment were depicted by a considerable number of handsome illustrations, the latter having been reproduced from photographs taken expressly for the purpose. The illustrations comprise not only views of the various buildings located in the gardens, but also several representations of such growing plants as are used medicinally, and which are of further interest on account of the chemical principles they contain. The detailed and precise information contained in this publication renders it of more than ephemeral value, and the favour with which it has been received by botanists, and others interested in botanical science throughout the world, has been manifested by many expressions of appreciation.

List of Specimens Exhibited

I. Chemical Preparations

Salts of the Alkaloids of Jaborandi Leaves

Pilocarpine Hydrobromide
Pilocarpine Nitrate
Pilocarpine Picrate
iso Pilocarpine Hydrobromide
iso Pilocarpine Nitrate
iso Pilocarpine Picrate
Pilocarpidine Nitrate

Substances relating to the Constitution of Pilocarpine

iso Pilocarpinolactone
Dibromopilocarpine
Dibromo*iso*pilocarpine
Dibromo*iso*pilocarpinic Acid
Barium Pilocarpinate
Pilopic Acid
Pilopic Amide
Barium Hydroxypilopate
α-Ethyltricarballylic Acid, from Homopilopic Acid
α-Ethyltricarballylic Acid, synthetic
Ethylic α-ethyl-β-cyanotricarballylate
4 : 5-Dibromo-1 : 3-dimethylpyrazole
1 : 3-Dimethylpyrazole
1 : 3-Dimethylpyrazole Methiodide
4 (or 5)-Methylglyoxaline
Methylamylglyoxaline Platinichloride
1 : 4 (or 1 : 5)-Dimethylglyoxaline
1 : 4 (or 1 : 5)-Dimethylglyoxaline Picrate
1 : 4 (or 1 : 5)-Dimethylglyoxaline Platinichloride
1 : 2-Dimethylglyoxaline
1 : 2-Dimethylglyoxaline Picrate
1 : 2-Dimethylglyoxaline Platinichloride
Ethylic ethylcyanosuccinate

Substances obtained in Researches on Morphine

iso Morphine
iso Morphine Hydrobromide
iso Morphine Hydrochloride
Bromomorphide
Bromomorphide Hydrobromide
Bromomorphide Hydrochloride
Chloromorphide
Chloromorphide Hydrobromide
Chloromorphide Hydrochloride
Acetylchloromorphide
Deoxymorphine Hydrochloride
Bromocodeide

Morpholones, and Derivatives produced by Electro-synthesis

β-Naphthomorpholone
N-Methyl-β-naphthomorpholone
N-Methylphenmorpholine Hydrochloride
N-Acetylmethylorthoaminophenol
N-Methylethylorthoaminophenol Hydrochloride
a-Nitro-β-naphthoxyacetic Acid
N-Methylethyl-*a*-amino-β-naphthol sulphocamphylate

Synthetic Tropeines

Tropeine Platinichloride
Glyoxyltropeine Nitrate
Methylparaconyltropeine Hydrobromide
Protocatechyltropeine Hydrochloride
Terebyltropeine Hydrobromide
Phthalid-carboxylic acid tropeine Hydrobromide

Gold Salts of Hyoscine and Hyoscyamine

Hyoscine Hydrobromide Gold Chloride
Hyoscyamine Hydrobromide Gold Chloride

Berberine Phosphate

Essential Oil from the Fruit of Pittosporum Undulatum, *Vent.*

Constituents of the Oil

Pinene Limonene Sesquiterpene

Essential Oil from the Leaves of Umbellularia Californica, *Nutt.* ("California Laurel")

Constituents of the Oil

Eugenol
Eugenol Methyl Ether
Pinene
Cineole
Safrole
Umbellulone

Substances relating to the Constitution of Umbellulone

Bromodihydroumbellulone
Dibromodihydroumbellulone
Umbellulonic Acid
Lactone of Umbellulonic Acid
Umbellularic Acid
Dibenzoylaminotetrahydroumbellulylamine
Lactone of δ-hydroxy-*a*-isopropylhexoic Acid

Essential Oil from the rhizome of Asarum Canadense, *Linné*. ("Wild Ginger")

Constituents of the Oil

Pinene
Linalool
Linalyl Acetate
Borneol
Bornyl Acetate
Geraniol
Geranyl Acetate
Terpineol
Blue Oil
Palmitic Acid
Eugenol Methyl Ether

Essential Oil of Algerian Rue

Constituents of the Oil

Pinene
Limonene
Cineole
Blue Oil
Methyl Salicylate
Methyl *n*-Heptyl Ketone
Methyl *n*-Nonyl Ketone
Methyl-*n*-heptylcarbinol
Methyl-*n*-nonylcarbinol

A Synthetic Ketone

Methyl β-Methylhexyl Ketone

Essential Oil of Hedeoma Pulegioides, *Persoon* ("American Pennyroyal")

Constituents of the Oil

Pinene
Limonene
Pulegone
Methyl*cyclo*hexanone
l-Menthone
d-iso Menthone
Salicylic Acid

Essential Oil of Nutmeg

Constituents of the Oil, and Derivatives

Pinene
Camphene
Dipentene
Linalool
Borneol
Terpineol
Geraniol
Safrole
Eugenol
iso Eugenol
Myristicin
Monocarboxylic Acid, $C_{12}H_{17}O{\cdot}CO_2H$

Dioxime of a Diketone, $C_8H_{14}O_2$
Dibromomyristicin Dibromide

Expressed Oil of Nutmeg

Constituents of the Oil

Trimyristin — Oleic Acid
Myristic Acid — Phytosterol
Viscid Substance

Constituents of the Seeds of Taraktogenos Kurzii, *King*

("Chaulmoogra Seeds")

Chaulmoogra Oil — Chaulmoogric Acid
A hydrolytic Enzyme — Hydnocarpic Acid

Derivatives of Chaulmoogric Acid

Ammonium Chaulmoograte — Lead Chaulmoograte
Lithium Chaulmoograte — Chaulmoogric Amide
Potassium Chaulmoograte — Ethyl Chaulmoograte
Zinc Chaulmoograte — Methyl Chaulmoograte
Iron Chaulmoograte — Dihydrochaulmoogric Acid
Copper Chaulmoograte — Methyl Dihydrochaulmoograte
Monobromodihydrochaulmoogric Acid

Substances relating to the Constitution of Chaulmoogric Acid

a-Dihydroxydihydrochaulmoogric Acid
β-Dihydroxydihydrochaulmoogric Acid
n-Pentadecane-*aáγ*-tricarboxylic Acid
Trimethyl *n*-pentadecane-*aáγ*-tricarboxylate
β-Methyl-γ-keto-*n*-pentadecane-*aá*-dicarboxylic Acid
Dimethyl β-methyl-γ-keto-*n*-pentadecane-*aá*-dicarboxylate
γ-keto-*n*-pentadecane-*aá*-dicarboxylic Acid
Dimethyl γ-keto-*n*-pentadecane-*aá*-dicarboxylate
n-Dodecanedicarboxylic Acid
n-Undecanedicarboxylic Acid

Constituents of the Seeds of Hydnocarpus Wightiana, *Blume*, and of Hydnocarpus anthelmintica, *Pierre* ("Lukrabo" Seeds)

Expressed Oil of Hydnocarpus Wightiana
Expressed Oil of Hydnocarpus anthelmintica
Chaulmoogric Acid — Hydnocarpic Acid

Derivatives of Hydnocarpic Acid

Hydnocarpamide
Methyl Hydnocarpate
n-Tridecane-$a\acute{a}\gamma$-tricarboxylic Acid
Trimethyl *n*-tridecane-$a\acute{a}\gamma$-tricarboxylate
n-Decanedicarboxylic Acid

Constituents of the Seeds of Gynocardia odorata, *R. Br.*

Gynocardia Oil

Palmitic Acid	Gynocardin
Phytosterol	Gynocardase

Substances isolated from Olive Leaves, and their Derivatives

Oleanol	Oleasterol
Diacetyloleanol	Olestranol
Methylacetyloleanol	Homo-olestranol
Hentriacontane	Pentatriacontane

d-Mannitol

Substances isolated from Olive Bark, and their Derivatives

Acid, $C_{24}H_{45}.CO_2H$	Ipuranol
Acid, $C_{29}H_{57}.CO_2H$	Diacetylipuranol
Acid, $C_{34}H_{69}.CO_2H$	Olenitol
Phytosterol	Acetylolenitol

d-Mannitol

Substances isolated from the Leaves of Eriodictyon Californicum (*Hooker et Arnott*), *Greene* ("Yerba Santa") and their Derivatives

Essential Oil	Phloroglucinol
Triacontane	Ferulic Acid
Pentatriacontane	Eriodictyol
Cerotic Acid	Acetyleriodictyol
Glucose (Osazone)	Homo-eriodictyol

Monosodium-homo-eriodictyol
Tetra-acetyl-homo-eriodictyol

Substances isolated from Morinda longiflora, *G. Don* ("Ojuologbo"), and their Derivatives

Hydroxymethoxymethylanthraquinone
1 : 3-Dihydroxy-2-methylanthraquinone
1 : 3-Dimethoxy-2-methylanthraquinone
Hydroxymethoxymethylanthraquinone Acetate
1 : 3-Dihydroxy-2-methylanthraquinone Diacetate
Dihydroxymethylanthranol
Morindanol

Substances isolated from Aethusa Cynapium, *Linné* ("Fool's Parsley")

Essential Oil
Volatile Alkaloid
d-Mannitol
Phytosterol
Pentatriacontane
Glucose (Osazone)

Substances isolated from Grindelia camporum, *Greene*

Essential Oil
Hentriacontane
Cerotic Acid
Alcoholic Substance, $C_{28}H_{58}O_4$

Substances isolated from the Leaves of Gymnema sylvestre, *R. Br.*, and Derivatives

l-Quercitol
Penta-acetyl-*l*-quercitol
Penta-benzoyl-*l*-quercitol
Gymnemic Acid
Hentriacontane

Substances isolated from Ipomœa purpurea, *Roth* ("Common Morning Glory"), and their Derivatives

Essential Oil
Crude Resin
Purified Resin
Pentatriacontane
Phytosterol
Ipurolic Acid
Sodium Ipurolate
Copper Ipurolate
Methyl Ipurolate
Diacetylipuranol
d-Methylethylacetic Acid

Substances isolated from the fruits of Brucea antidysenterica, *Lam.*

Fatty Oil
Oleic Acid
Palmitic Acid
Stearic Acid
Glucose (Osazone)

Substances isolated from the fruits of Brucea Sumatrana, *Roxb.* ("Kô-sam")

Fatty Oil
Oleic Acid
Palmitic Acid
Stearic Acid
Hentriacontane
Rhamnol
Bitter Principle
Enzyme

Substances isolated from Cascara Sagrada

Emodin
Rhamnol
Rhamnol Acetate
Syringic Acid
Arachidic Acid
Enzyme

Substances isolated from Micromeria Chamissonis (*Benth.*), *Greene* ("Yerba Buena") and their Derivatives

Essential Oil
Xanthomicrol
Micromerol
Methylmicromerol
Micromeritol
Diacetylmicromeritol

Substances isolated from Lippia Scaberrima, *Sonder* ("Beukess Boss")

Essential Oil
Heptacosane
Hentriacontane
Phytosterol
Arachidic Acid
Lippianol

Substances isolated from the stems of Derris uliginosa, *Benth.*

Active Resin
Inactive Resin
Ceryl Alcohol
Phytosterol
Arachidic Acid
Stearic Acid

Salinigrin, a Glucoside from the bark of Salix discolor, *Muhl.*, and its hydrolytic products

Salinigrin
Metahydroxybenzaldehyde Glucose

A poisonous Protein from the bark of Robinia Pseud-acacia, *Linné* ("Common Locust")

Robin

The Constituents of Commercial Chrysarobin, and Substances relating to the Constitution of Chrysophanic Acid and Emodin

Chrysarobin, commercial
Chrysarobin
Triacetylchrysarobin
Dichrysarobin
Methyldichrysarobin
Acetylmethyldichrysarobin
Chrysophanic Acid, from Chrysarobin
Emodin Monomethyl Ether
1 : 5-Dihydroxydimethylanthraquinone
3 : 5-Dihydroxydimethylanthraquinone
Diacetyldihydroxydimethylanthraquinone

Derivatives of Gallic Acid

Ethyl Triacetylgallate
Ethyl Dinitrogallate
Ethyl Sodiumdinitrogallate
Ethyl Dinitrodiacetylgallate
Ethyl Dinitrotriacetylgallate
Ethyl Diazogallate
Ethyl Monaminogallate Hydrochloride

Benzoxy-olefines

β-Benzoxyhexylene
β-Benzoxynonylene
β-Benzoxyundecylene
β-Valeroxyundecylene
a Benzoxyheptylene
a-Benzoxy-*a*-phenylethylene
β-Benzoxy-γ-methylheptylene
Benzoxycamphene

Phenylic Salts of Camphoric Acid

Guaiacyl Camphorate
Guaiacyl Zinc Camphorate
Guaiacyl Hydrogen Camphorate
Eugenyl Hydrogen Camphorate
Thymyl Hydrogen Camphorate

also

Menthyl Hydrogen Camphorate
Santalyl Hydrogen Camphorate

Salts of Natural and Synthetical Glycerylphosphoric Acids

Lithium Glycerylphosphate
Barium Glycerylphosphate
Calcium Glycerylphosphate
Strontium Glycerylphosphate
Zinc Glycerylphosphate
Manganese Glycerylphosphate
Iron Glycerylphosphate
Copper Glycerylphosphate

Brucine Salt of Glycerylphosphoric Acid from Lecithin
Brucine Salt of Synthetical Glycerylphosphoric Acid
Brucine Salt of *a*-Glycerylphosphoric Acid
Brucine Salt of β-Glycerylphosphoric Acid
Calcium β-Diglycerylphosphate

New Preparations of Manganese, Iron and Bismuth

Manganese Citrate (Soluble)
Manganese and Iron Citrate
Manganese and Iron Phosphate
Ferric Hypophosphite (Soluble)
Bismuth Citrate (Soluble)
Bismuth and Iron Citrate
Bismuth and Lithium Citrate
Ferric Arsenate (Soluble)

II. BOTANICAL AND MATERIA MEDICA SPECIMENS

Aleppo Galls (*Quercus infectoria*, Olivier + *Cynips Gallæ tinctoriæ*, Olivier)
" Beukess Boss " (*Lippia scaberrima*, Sonder)
Brucea fruits (*Brucea antidysenterica*, Lam.)
Californian Laurel leaves (*Umbellularia Californica*, Nutt.)
Cascara Sagrada (*Rhamnus Purshianus*, DC.)
Chaulmoogra seeds (*Taraktogenos Kurzii*, King)
Derris stems (*Derris uliginosa*, Benth.)
Golden Seal rhizome (*Hydrastis Canadensis*, Linné)
Grindelia (*Grindelia camporum*, Greene)
Gymnema leaves (*Gymnema sylvestre*, R.Br.)
Gynocardia seeds (*Gynocardia odorata*, R.Br.)
Henbane leaves (*Hyoscyamus niger*, Linné)
Hydnocarpus seeds (*Hydnocarpus Wightiana*, Blume)
Jaborandi leaflet (*Pilocarpus Jaborandi*, Holmes)
Jaborandi leaflets (*Pilocarpus microphyllus*, Stapf)
" Kô-sam " fruits (*Brucea Sumatrana*, Roxb.)
Locust bark (*Robinia Pseud-acacia*, Linné)
" Lukrabo " seeds (*Hydnocarpus anthelmintica*, Pierre)
Morning Glory, common (*Ipomœa purpurea*, Roth)
" Ojuologbo " leaves (*Morinda longiflora*, G. Don)
" Ojuologbo " root (*Morinda longiflora*, G. Don)
Olive bark (*Olea Europæa*, Linné)
Olive leaves (*Olea Europæa*, Linné)
Rhubarb rhizome (*Rheum officinale*, Baill. [?])
Strophanthus pods (*Strophanthus Kombe*, Olivier)
Strophanthus seed (*Strophanthus Arnoldianus*, De Wildem. et Durand)
Strophanthus seed (*Strophanthus Courmonti*, Sacl.)
Strophanthus seed (*Strophanthus Courmonti*, Sacl. var. *fallax*, Holmes)
Strophanthus seed (*Strophanthus Courmonti*, Sacl. var. *Kirkii*, Holmes)
Strophanthus seed (*Strophanthus gratus*, Franch.)
Strophanthus seed (*Strophanthus hispidus*, DC.)
Strophanthus seed (*Strophanthus Kombe*, Olivier)
Strophanthus seed (*Strophanthus Nicholsoni*, Holmes)
Strophanthus seed (*Strophanthus Nicholsoni*, Holmes [immature])
Strophanthus seed (*Strophanthus Preussii*, Pax)
Wild Ginger rhizome (*Asarum Canadense*, Linné)
Willow bark (*Salix discolor*, Muhl.)
Yerba Buena (*Micromeria Chamissonis* [Benth.], Greene)
Yerba Santa (*Eriodictyon Californicum* [Hooker et Arnott], Greene)

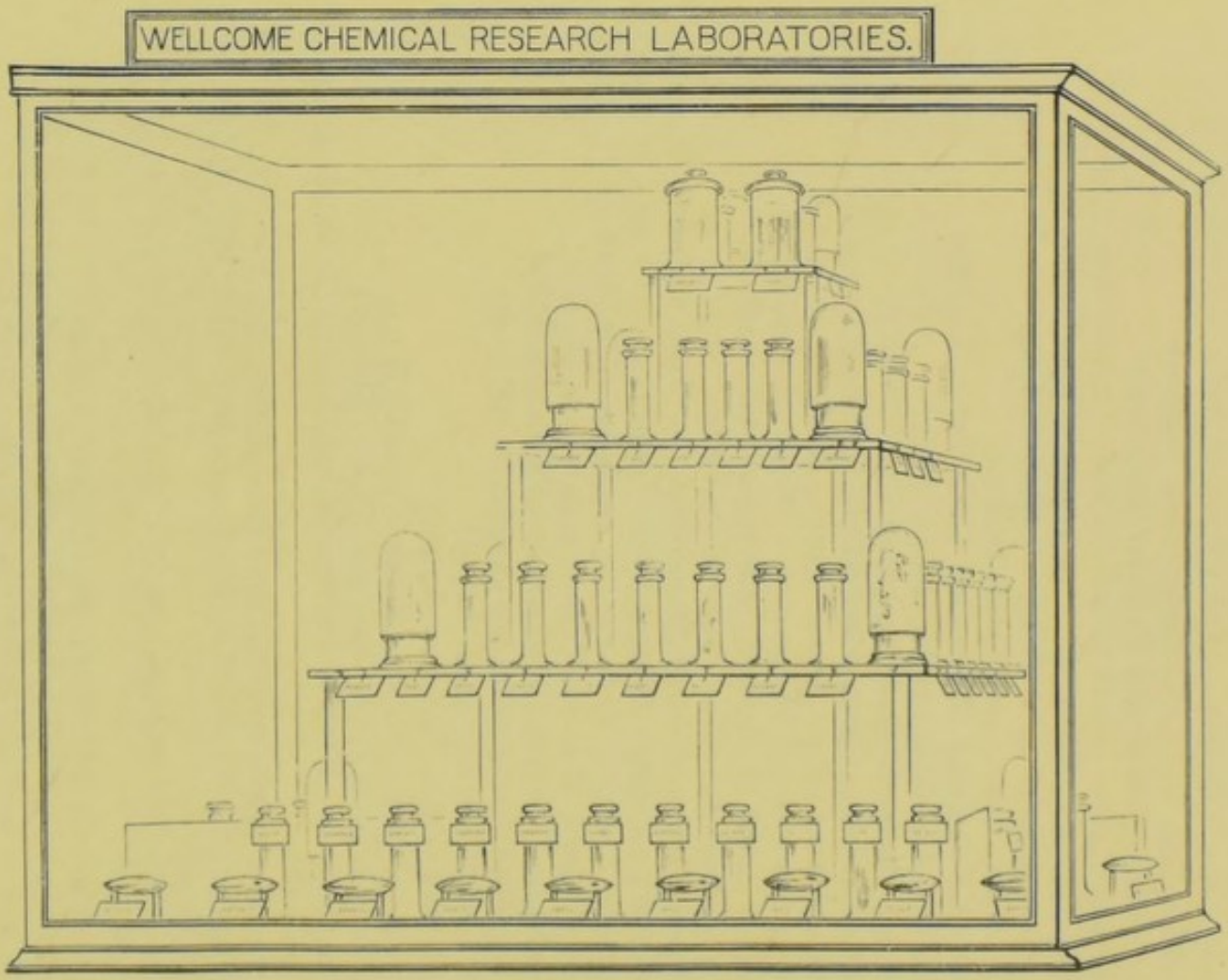


EXHIBIT OF THE WELLCOME CHEMICAL RESEARCH LABORATORIES

Science Section—Hall of Science—Table No. 107

B. Exhibit in Science Section

Hall of Science. Table No. 107

Pilocarpine Nitrate
Pilocarpine Picrate
iso Pilocarpine Nitrate
iso Pilocarpine Picrate
Pilocarpidine Nitrate
iso Pilocarpinolactone
a-Ethyltricarballylic Acid
Hyoscine Hydrobromide
iso Morphine Hydrobromide
Bromomorphide Hydrobromide
Chloromorphide Hydrochloride
Bromocodeide
Protocatechyltropeine Hydrochloride
Terebyltropeine Hydrobromide
Berberine Phosphate
Umbellulone
Dibromodihydroumbellulone
Oxime of Umbellulonic Acid
Aminotetrahydroumbellulylamine Dibenzoate
d-iso Menthone Semicarbazone
Eugenol Diphenylurethane
Myristicin
iso Myristicin
Dibromomyristicindibromide
Oleanol
Diacetyloleanol
Methylacetyloleanol
Homo-olestranol
Triacontane
Hentriacontane
Pentatriacontane
Eriodictyol
Homo-eriodictyol
Lippianol

Micromerol
Mono-acetylmicromeritol
Xanthomicrol
Hydroxymethoxymethylanthraquinone
Hydroxymethoxymethylanthraquinone Acetate
1 : 3-Dimethoxy-2-methylanthraquinone
Morindanol
Salinigrin
Chaulmoogra Oil
Chaulmoogric Acid
Ammonium Chaulmoograte
Copper Chaulmoograte
Dihydrochaulmoogric Acid
Methyl Dihydrochaulmoograte
Trimethyl *n*-pentadecane-*aáγ*-tricarboxylate
Dimethyl *β*-methyl-*γ*-keto-*n*-pentadecane-*aá*-dicarboxylate
Dimethyl *γ*-keto-*n*-pentadecane-*aá*-dicarboxylate
n-Undecanedicarboxylic Acid
Hydnocarpic Acid
Gynocardia Oil
Gynocardin
Gynocardase
3 : 5-Dihydroxydimethylanthraquinone
Emodin, from Cascara Sagrada
Acetylbarbaloin
Tribromobarbaloin
Acetyltribromobarbaloin
Benzoxycamphene
Barium Salt of *a*-Glycerylphosphoric Acid
Barium Salt of *β*-Glycerylphosphoric Acid
l-Quercitol
Ipurolic Acid
β-Naphthomorpholone
Manganese Citrate (Soluble)
Ferric Arsenate (Soluble)
Bismuth and Lithium Citrate

TITLES OF PUBLISHED PAPERS FROM THE WELLCOME CHEMICAL RESEARCH LABORATORIES

1. Some new gold salts of Hyoscine, Hyoscyamine and Atropine
2. The characters and methods of assay of the official Hypophosphites
3. Note on the mydriatic Alkaloids
4. Preparation of Acid Phenylic Salts of Dibasic Acids
5. A new method for the analysis of commercial Phenols
6. The assay of preparations containing Pilocarpine
7. Pilocarpine and the alkaloids of Jaborandi Leaves
8. A new glucoside from Willow Bark
9. The constitution of Pilocarpine—Part I
10. The composition and determination of Cerium Oxalate
11. Researches on Morphine—Part I
12. Observations relating to the Chemistry of the British Pharmacopœia
13. Mercurous Iodide
14. The composition of Berberine Phosphate
15. A contribution to the Pharmacognosy of official Strophanthus Seed
16. The chemistry of the Jaborandi Alkaloids
17. A new admixture of commercial Strophanthus Seed

18. Researches on Morphine—Part II

19. The constitution of Pilocarpine—Part II

20. The chemistry of the bark of Robinia Pseud-acacia, *Linné*

21. The anatomy of the bark of Robinia Pseud-acacia, *Linné*

22. A soluble Manganese Citrate and compounds of Manganese with Iron

23. The chemical characters of so-called Iodo-tannin Compounds

24. The constitution of Pilocarpine—Part III

25. A new Synthesis of *a*-Ethyltricarballylic Acid

26. The constituents of the essential oil of Asarum Canadense, *Linné*

27. Derivatives of Gallic Acid

28. The occurrence of Salicin in different Willow and Poplar Barks

29. The constituents of commercial Chrysarobin

30. The constituents of an essential oil of Rue

31. Methyl *β*-Methylhexyl Ketone

32. Interaction of Ketones and Aldehydes with Acid Chlorides

33. The anatomy of the stem of Derris uliginosa, *Benth.*

34. The chemistry of the stem of Derris uliginosa, *Benth.*

35. The constitution of Pilocarpine—Part IV

36. Preparation and properties of Dimethyl-glyoxaline and Dimethylpyrazole

37. The electrolytic reduction of Pheno- and Naphthomorpholones

38. Chemical examination of Kô-sam Seeds (Brucea Sumatrana, *Roxb.*)

39. Comparative anatomy of the Barks of the Salicaceæ—Part I

40. The constitution of Chrysophanic Acid and of Emodin

41. The constitution of Epinephrine

42. A Lævo-rotatory modification of Quercitol

43. The constituents of the essential oil of Californian Laurel

44. Some derivatives of Umbellulone

45. The constituents of Chaulmoogra Seeds

46. The constitution of Chaulmoogric Acid—Part I

47. Chemical examination of Cascara Bark

48. Chemical examination of Gymnema Leaves

49. The relation between Natural and Synthetical Glycerylphosphoric Acids

50. Gynocardin, a new Cyanogenetic Glucoside

51. Preparation and Properties of 1 : 4 : 5-Trimethylglyoxaline

52. The constitution of Pilocarpine—Part V

53. The constitution of Barbaloin—Part I

54. The constituents of the Seeds of Hydnocarpus Wightiana, *Blume*, and of Hydnocarpus anthelmintica, *Pierre*

55. The constituents of the Seeds of Gynocardia odorata, *R. Br.*

56. The Synthesis of Substances allied to Epinephrine

57. Chemical examination of Grindelia

58. Chemical examination of Aethusa Cynapium, *Linné*

59. Preparation and properties of some new Tropeines

60. The constituents of the essential oil from the fruit of Pittosporum undulatum, *Vent.*

61. The constitution of Umbellulone

62. London Botanic Gardens

63. Chemical and physiological examination of the Fruit of Chailletia toxicaria

64. Chemical examination of Eriodictyon

65. The botanical characters of some Californian species of Grindelia

66. The relation between natural and synthetical Glycerylphosphoric Acids—Part II

67. The constitution of Umbellulone—Part II

68. The reduction of Hydroxylaminodihydro-umbelluloneoxime

69. The constitution of Chaulmoogric and Hydnocarpic Acids

70. The constituents of the Essential Oil of American Pennyroyal

71. The constitution of Homo-eriodictyol

72. The interaction of Methylene Chloride and the Sodium Derivative of Ethyl Malonate

73. Chemical examination of the Fruit of Brucea antidysenterica, *Lam.*

74. Chemical examination of the Barks of Brucea antidysenterica, *Lam.*, and Brucea sumatrana, *Roxb.*

75. Chemical examination of Grindelia—Part II

76. Chemical examination of Lippia scaberrima, *Sonder* ("Beukess Boss")

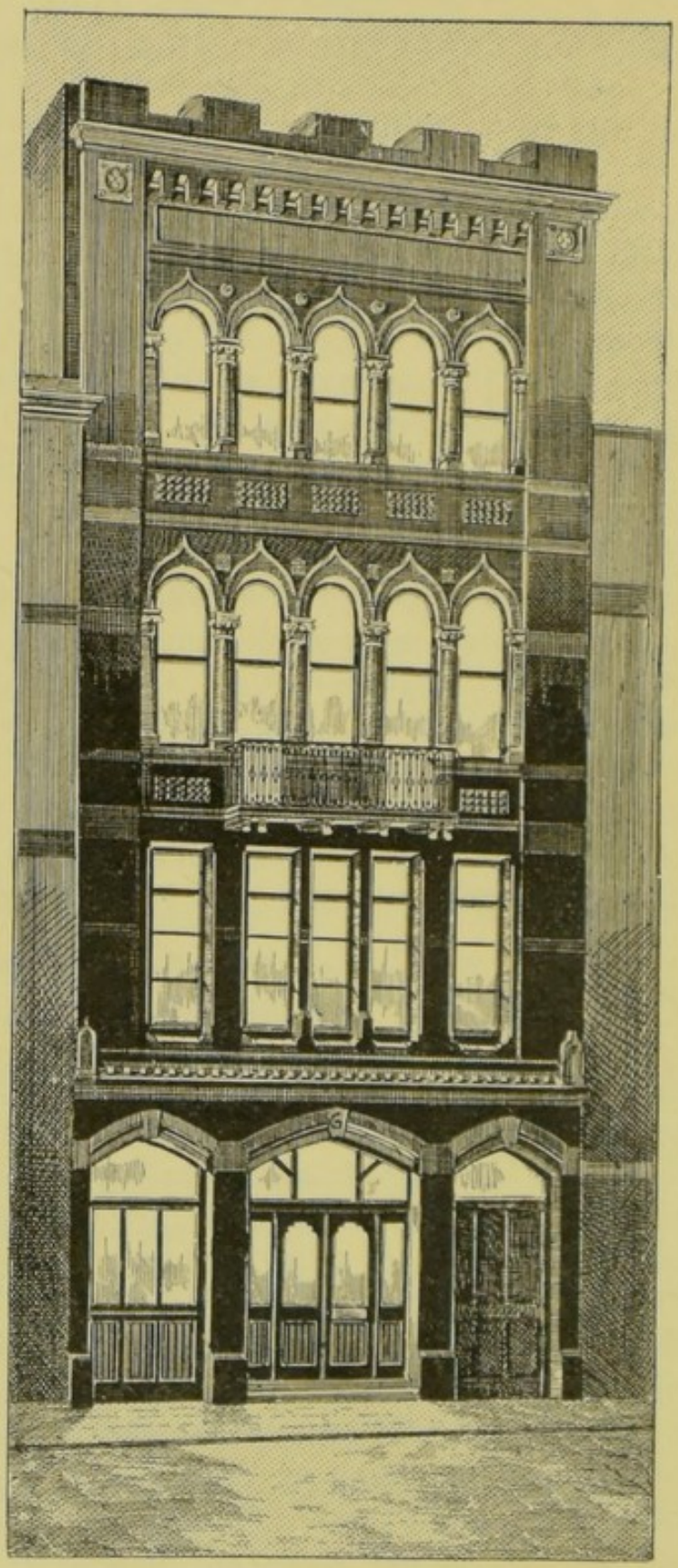
77. Chemical examination of the root and leaves of Morinda longiflora

THE WELLCOME
CHEMICAL RESEARCH LABORATORIES

ORGANISATION, EQUIPMENT AND DEVELOPMENT

Those who have observed the progress of events in Great Britain during the last decade cannot fail to have been impressed with the remarkable developments and achievements by which it has been attended, especially in the domains of the chemical, physical and biological sciences. The discovery within the past few years of several new elements in the atmosphere, the liquefaction, and even solidification, of gases that were hitherto regarded as permanent, the synthesis of several important organic compounds, the isolation of new substances, and the more precise characterisation of those previously known, together with the perfection of chemical processes and the applications of electricity in chemical and metallurgical operations, are but a few examples of the contributions to knowledge and the industrial progress which have signalised the closing years of the past and the beginning of the new century.

The spirit of research has, in fact, now become so diffused as to have penetrated into almost every department of human knowledge and activity. With a broader recognition of its usefulness, and even of its necessity, as an element of progress, research is no longer confined to institutions of learning, but has proved to be a quite indispensable factor in its relation to industrial pursuits, as well as for the study of those important problems in medical science which are so intimately associated with the health and happiness of mankind. It has indeed been truly said that "without a knowledge of the constitution or structure of the molecules which go to make up the substances employed as remedies, therapeutics, or the administration of these remedies, can never be an exact science. Thus the research chemist may contribute, though indirectly, his share towards placing medicine upon a real and scientific basis."



THE WELLCOME CHEMICAL RESEARCH LABORATORIES

It is worthy of note that the year 1896 was marked by the establishment in Great Britain of at least three laboratories devoted exclusively to scientific research—namely, the Davy-Faraday Research Laboratory connected with the Royal Institution, which was formally inaugurated in December, 1896; the new Research Laboratory of the Royal College of Physicians of Edinburgh, which was formally opened in November, 1896; and the WELLCOME CHEMICAL RESEARCH LABORATORIES, which were established in the summer of 1896.

The scope of these laboratories and the directions in which research is conducted in them, naturally differ. The first-mentioned, for example, is more especially of an academic character, and is therefore devoted to somewhat abstract investigations in chemistry and physics; the second is stated to have for its primary object the examination of morbid specimens and material, the study of zymotic diseases, and, in general, bacteriological, physiological and pathological work; while the third, the WELLCOME CHEMICAL RESEARCH LABORATORIES, are designed for investigations in both pure and applied chemistry, and, in the latter instance, with special reference to the study of that large class of both organic and inorganic compounds which are employed as medicinal agents in the treatment of disease.

The importance of the work which it is the purpose to accomplish in these different, but more or less closely related, departments of science is apparent, and is duly appreciated by those who recognise the deficiencies of existing knowledge.

In response to numerous requests, it has been considered that a brief sketch of the WELLCOME CHEMICAL RESEARCH LABORATORIES, descriptive of their organisation, equipment and development would prove of interest to a considerable number who have not the opportunity of inspecting them.

THE LABORATORIES—FIRST FLOOR

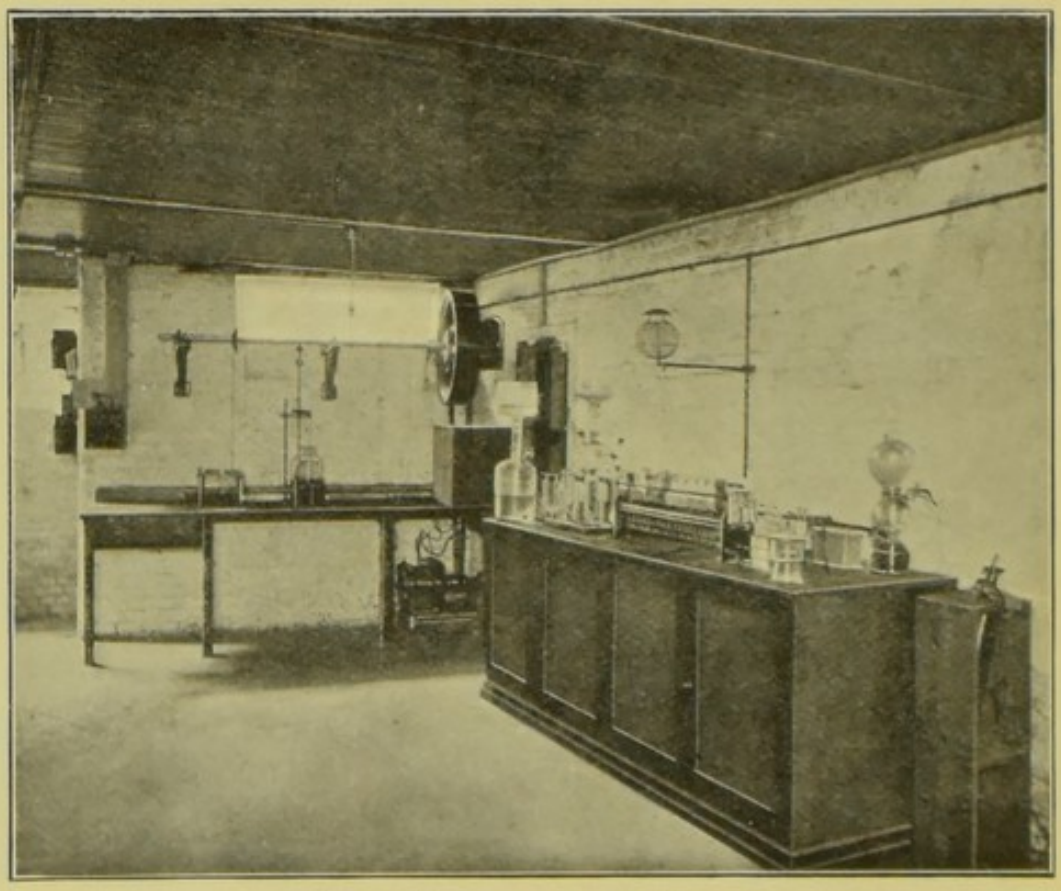
THE LABORATORIES—SECOND FLOOR

The first announcement of the plan of Mr. Henry S. Wellcome to establish the Chemical Research Laboratories which bear his name, was made on the occasion of a dinner given by him to the present Director, Dr. Frederick B. Power, at the Holborn Restaurant, London, on the evening of July 21, 1896. The occasion was a memorable one in many respects, for the gathering included a large number of distinguished representatives of the various sections of the scientific world. It was then explained by Mr. Wellcome that the work which he proposed to inaugurate was one which he personally had very much at heart, that it would be carried out on no selfish lines, but would be controlled and dictated with the highest regard for science. It was also made clear that the new Chemical Research Laboratories were to be entirely distinct from those of the Works of his firm, in which, as heretofore, research would also continue to be conducted. The expressions of appreciation of the high purpose and the scientific spirit which had actuated Mr. Wellcome in the development of such extended plans for chemical research, as manifested by various distinguished speakers on the occasion referred to, were indeed most auspicious, and fittingly commemorated the inauguration of the work that was to be undertaken.

The first home of the laboratories was in a building located at No. 42, Snow Hill, but it was soon found desirable to make considerable extensions. In order to accomplish this, it was decided that the laboratories should be transferred to a building of their own, of which they should have complete use and possession. Such premises were secured at No. 6, King Street, Snow Hill, where, in a very central part of London, and amid surroundings replete with many of its most interesting historical associations, the laboratories are now located.

The building is a handsome, modern one of Venetian style of architecture, and comprises four stories and a basement. A view of it is represented on *page* 44.

THE LABORATORIES—THIRD FLOOR



THE COMBUSTION ROOM

On the ground floor of the building are the office of the Director, and the library, the latter being quite complete for the special requirements. It contains not only a considerable number of recent chemical and pharmacological works, but also complete sets of many journals, such as the *Journal of the Chemical Society*, *Berichte der deutschen chemischen Gesellschaft*, the *Chemical News*, *Journal of the Society of Chemical Industry*, etc. Files of many of the more important chemical, pharmaceutical and medical periodicals of England, America and Germany are also kept. As several very large and complete scientific and technical libraries are also at all times accessible to members of the staff, it is evident that the requirements in this direction are most abundantly supplied. In the library there is also a cabinet containing specimens of the various substances obtained in the course of laboratory investigations, which already form a collection of considerable interest.

The laboratories proper are located on the first, second and third floors of the building, and are represented on *pages* 46 *and* 48. They are similar in their arrangement, are provided with gas and electricity for both illuminating and heating purposes, and completely equipped with all the necessary apparatus and appliances for conducting chemical investigations. There are pumps on each table for filtration under pressure, and special adaptations for vacuum distillations. A separate connection with the electric mains supplies the current for heating iron plates used for the distillation of ether and other similar liquids. Each laboratory is provided with fine analytical and ordinary balances, which are carefully protected from dust and moisture by tightly-fitting glass cases. There are also telephones on each floor, so that communication between the different laboratories or with the Director's office can be quickly effected.

The basement of the building, which is well-lighted by electricity, contains a combustion furnace and all the

appliances for conducting ultimate analyses, whilst two other furnaces of the most approved construction are available in the laboratories; it also contains a large electric motor for working the shaking and stirring apparatus, the drug mill, etc., and a dark room adapted for polarimetric or photographic work. A view of a portion of the combustion room is shown on *page* 48. In direct communication with the basement are dry and commodious vaults, which afford ample room for the storage of the heavier chemicals and the reserve stock of glass-ware, etc. By means of a small lift, articles may be conveniently transported from the basement to any floor of the building.

From this brief description, and the accompanying photographic illustrations, it will be seen that the WELLCOME CHEMICAL RESEARCH LABORATORIES are unique in their appointments and in the purpose they are designed to accomplish.

It is, perhaps, hardly necessary to explain that some of the problems which engage the time and attention of members of the staff—which comprises a number of highly-skilled and experienced chemists — are of technical application, having reference to the perfection of the chemical products of Burroughs Wellcome & Co. These naturally do not always afford material for publication, and many other difficult researches extend over considerable periods of time. Nevertheless, a considerable number of publications, embodying the results of original work contributed to various scientific societies, which are now consecutively numbered, have already been issued. Other investigations in progress will, from time to time, form the subjects of future communications.

Although too short a period has elapsed since the establishment of these laboratories to afford much material for a historical retrospect, their present measure of success may be considered to have justified the expectations of their founder and of those who are in sympathy with the work which they aim to accomplish.

THE

WELLCOME CHEMICAL RESEARCH LABORATORIES

WERE AWARDED

ONE GRAND PRIZE

AND

THREE GOLD MEDALS

AT THE

INTERNATIONAL EXPOSITION AT ST. LOUIS, 1904

ONE GRAND PRIZE

ONE DIPLOMA OF HONOUR

AND

TWO GOLD MEDALS

AT THE

INTERNATIONAL EXHIBITION AT LIÉGE, 1905

ONE GRAND PRIZE

AT THE

INTERNATIONAL EXHIBITION AT MILAN, 1906

GRAND PRIZE
ST LOUIS

for Chemical and

Pharmacognostical

Research,

etc.. etc.

GRAND PRIZE
LIÉGE

GRAND PRIZE - MILAN