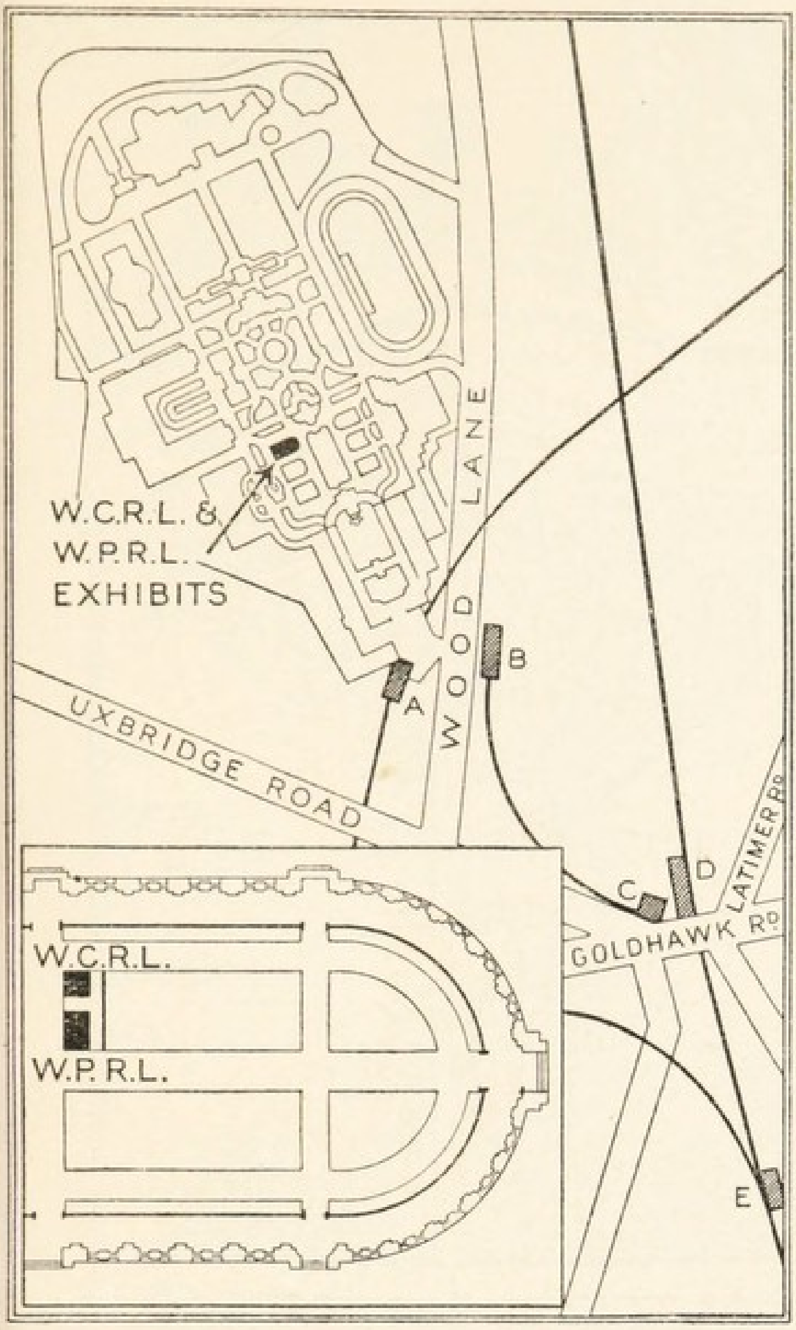
Exhibits at the Anglo-American Exposition, London 1914 / Frederick B. Power, Director of the Laboratories.

THE WELLCOME CHEMICAL RESEARCH LABORATORIES LONDON

F. B. Power, Ph.D., LL.D.
Director

WITH A
DESCRIPTION OF THE EXHIBITS
OF THESE LABORATORIES
AT THE
-AMERICAN
OSITION
ON, 1914



A Wood Lane Station (Met. R.)

B Wood Lane Station (C.L.R.)

C Shepherd's Bush Station (C.L.R.)

D Uxbridge Road Station (Met. R.)

E Addison Road Station

Plan showing the positions of the Exhibits of
THE WELLCOME
CHEMICAL RESEARCH LABORATORIES
and of
THE WELLCOME
PHYSIOLOGICAL RESEARCH LABORATORIES
in the
CHEMICAL SCIENCE BUILDING
ANGLO-AMERICAN EXPOSITION
LONDON, 1914

SECTIONAL INDEX

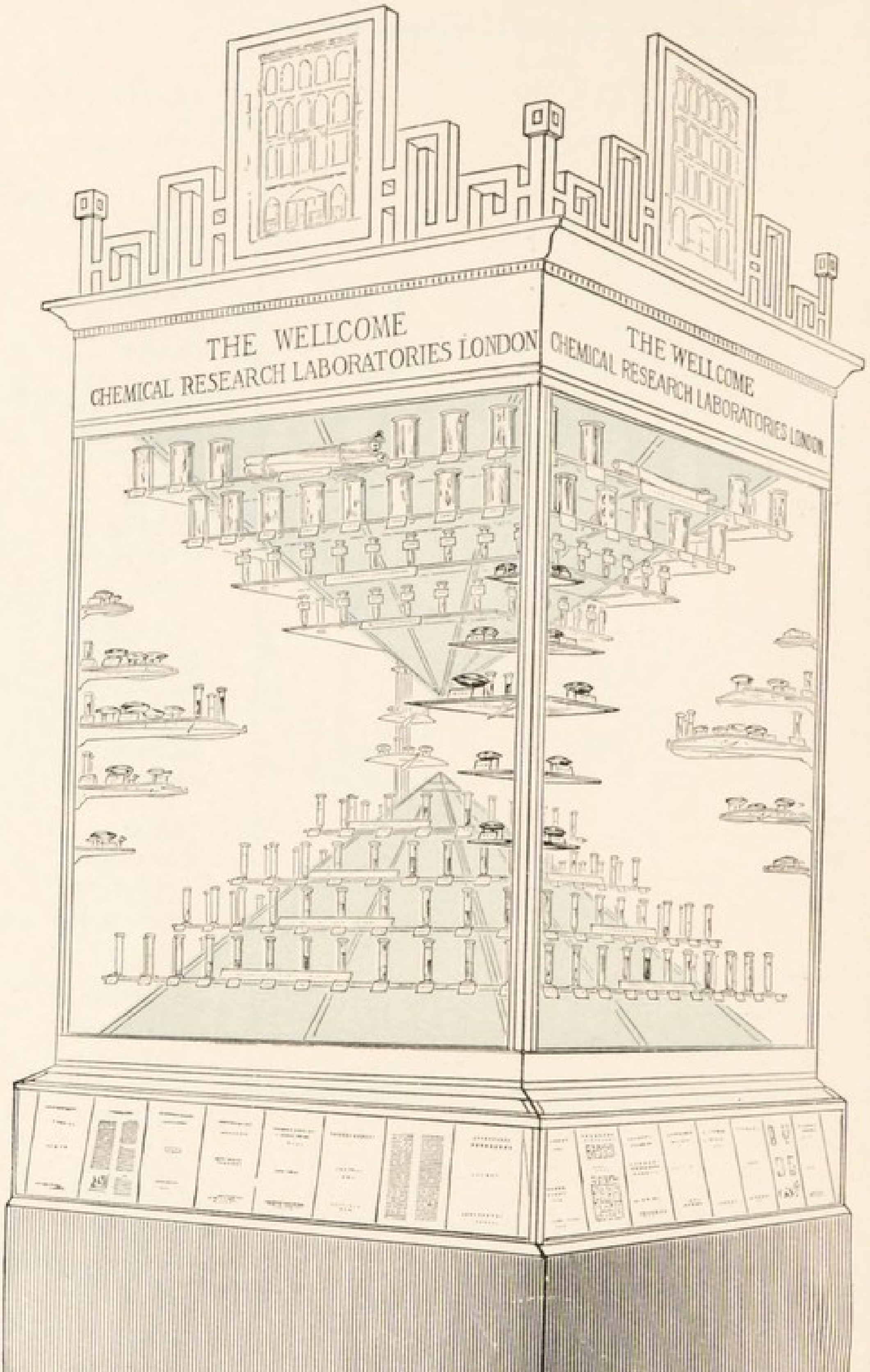


Exhibit of the
Wellcome Chemical Research Laboratories
Chemical Science Section
Anglo-American Exposition, London, 1914

THE WELLCOME
CHEMICAL RESEARCH LABORATORIES

EXHIBITS
AT THE
ANGLO-AMERICAN EXPOSITION
LONDON
1914

FREDERICK B. POWER, PH.D., LL.D.
Director of the Laboratories

KING STREET, SNOW HILL, LONDON

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EXHIBIT OF
THE WELLCOME CHEMICAL RESEARCH LABORATORIES
AT THE
ANGLO-AMERICAN EXPOSITION, LONDON, 1914

THIS Exhibit is 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 the scientific researches upon which it is 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, amongst 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 *Pharmaceutical Journal* (London); 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 to outline briefly the more important results of the work thus far accomplished. It may be noted, however, that in this Exhibit 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.

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 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. 192-197; 1905, **87**, pp. 967-974).

The results of a further research on this subject, entitled "Syntheses in the Epinephrine Series," are recorded in the *Journ. Chem. Soc.*, 1909, **95**, pp. 2113-2126, and, under the same title (Part II.), an account has been given of "the formation and properties of some 2 : 5- and 2 : 6-substituted pyrazines and their conversion into amino-ketones and imino-diketones." In the last-mentioned research numerous salts and derivatives of the respective compounds were described, together with their absorption spectra (*Journ. Chem. Soc.*, 1910, **97**, pp. 2495-2524 and pp. 2524-2534).

In one of the preceding investigations (*loc. cit.*, 1909, **95**, p. 2113) the base *a*-*p*-hydroxyphenylethylamine was described, and it was subsequently deemed of interest to ascertain whether the optically active bases obtained by its resolution would differ in physiological activity. In the same connection *a*-*p*-hydroxy-*m*-methoxyphenylethylamine was prepared and characterised, and its physiological action determined (*Journ. Chem. Soc.*, 1911, **99**, pp. 416-421).

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).

THE CONFIGURATION OF TROPINE AND ψ-TROPINE AND THE RESOLUTION OF ATROPINE

With the object of definitely establishing the configuration of tropine and ψ-tropine, experiments were conducted on the resolution of these bases, and some of their derivatives, by fractionally crystallising their salts with certain optically active acids. The results of these experiments led to the conclusion that the bases in question are internally compensated compounds. Further and conclusive proof of this conclusion was obtained by a study of the resolution of atropine. By submitting atropine *d*-camphorsulphonate to fractional crystallisation its resolution was readily affected, and only two salts were obtained, namely, *d*- and *l*-hyoscyamine *d*-camphorsulphonates. Atropine must, therefore, contain only one racemic asymmetric carbon atom, namely, that contained in the tropic acid complex (*Journ. Chem. Soc.*, 1909, **95**, pp. 1966, 1977).

THE RESOLUTION OF BENZOYLOSCINE

The base oscine (scopoline), $C_8H_{13}O_2N$, formed by the hydrolysis of the alkaloid hyoscine (scopolamine), is generally acknowledged to be closely related structurally to tropine, $C_8H_{15}ON$, although its constitution is not known. Tropine, which contains two similar asymmetric carbon atoms, having already been examined from a stereochemical point of view, as above noted, it was considered of interest to investigate oscine in the same direction. For the purpose of this investigation, benzoyl-oscine was employed, and it was found that this could be resolved by the fractional crystallisation of its *d*-bromocamphorsulphonate. One stereoisomeride, namely, benzoyl-*d*-oscine-*d*-bromocamphorsulphonate, was thus obtained in a state of purity (*Journ. Chem. Soc.*, 1910; 97, pp. 1793-1797).

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, and *Pharm. Journ.*, 1900, 65, p. 89).

QUININE SALTS

The official tests for the purity of quinine salts, especially with regard to the limitations they impose upon the presence of other cinchona alkaloids, have been made the subject of a very complete and critical study. It has thus been shown that there are sources of error involved in the application of the so-called "ammonia test" which had not hitherto been observed, and certain discrepancies in some of the recorded optical rotations of quinine salts were likewise noted (*Pharm. Journ.*, 1909, 83, pp. 600-603).

THE SYNTHESIS OF SUBSTANCES ALLIED TO COTARNINE

In this research a number of substances allied to cotarnine were prepared and characterised. The investigation, furthermore, resulted in some interesting observations respecting "the action of nitric acid on the ethers of aromatic hydroxyaldehydes," and this was therefore made the subject of an independent study (*Journ. Chem. Soc.*, 1909, **95**, pp. 1155-1165 and pp. 1204-1220).

SYNTHESIS OF COTARNINE

The initial substance employed for this synthesis was myristicin, $C_{11}H_{12}O_3$, a constituent of the essential oil of nutmeg. By an extended series of reactions a base, $C_{12}H_{13}O_3N$, was obtained, which was proved to be identical in all respects with cotarnine, as produced by the oxidation of the opium alkaloid, narcotine. In connection with this synthesis an isomeride of cotarnine was also obtained, which has been designated *neo*cotarnine (*Journ. Chem. Soc.*, 1910, **97**, pp. 1208-1219).

. In the course of the above-mentioned investigations which led to the synthesis of cotarnine, a by-product was obtained in an amount sufficient for its separate examination. The properties of the particular compound gave rise to a more general study of "the action of sodium amalgam on methylene ethers," and from the results thus obtained some deductions of considerable chemical interest could be formed (*ibid.*, 1910, **97**, pp. 2413-2418).

A special investigation was also undertaken for the purpose of determining "the orientation of the nitro-group in nitromyristicinic acid." This served not only to establish the constitution of the respective acid and the corresponding aldehyde, but also that of a series of synthetic products obtained from the latter compound (*ibid.*, 1911, **99**, pp. 266-270).

SOME NEW GOLD SALTS

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

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).

BENZOXY-OLEFINES

The investigation of the constituents of the above-mentioned essential oil of Algerian Rue 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).

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 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 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 contains 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. In the course of the investigation there were isolated from the unsaponifiable constituents of the oil a phytosterol, $C_{20}H_{34}O$, and a new compound, which appears to possess the formula $C_{18}H_{22}O_5$ (*Journ. Chem. Soc.*, 1908, **93**, pp. 1653-1659).

From the material (" press-cake ") remaining after the expression of the fatty oil, a number of other products were obtained (*Amer. Journ. Pharm.*, 1908, **80**, pp. 563-580).

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 indicated on *page* 16, 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).

A further investigation of the characters of the glucoside gynocardin, and of the enzyme gynocardase, has shown that both of these compounds belong to the β-series. It has been found that gynocardin possesses feebly acidic properties, yielding compounds with the alkali metals. The action of emulsin and of gynocardase on gynocardin, amygdalin, *l*-mandelonitrile glucoside, and salicin has also been quantitatively determined (*Journ. Chem. Soc.*, 1910, **97**, pp. 1285-1289).

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 (*Journ. Chem. Soc.*, 1908, **93**, pp. 891-904; 904-917. Compare also *Pharm. Journ.*, 1908, **81**, p. 714).

One of the crystalline constituents of olive leaves which had been isolated in the course of the above-mentioned investigation possessed the formula $C_{31}H_{50}O_3$, and was designated *oleanol*. This compound has been made the subject of further chemical study, and a number of interesting derivatives have been prepared from it (*Journ. Chem. Soc.*, 1913, **103**, pp. 2050-2060).

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).

A further examination of the constituents of *Eriodictyon*, with the use of a portion of the same lot of extract as had been employed for the previous investigation, resulted in the isolation of two new compounds, which have been designated, respectively, *xanthoeridol*, $C_{18}H_{11}O_4(OH)_3$, and *eriodonol*, $C_{19}H_{14}O_3(OH)_4$. A substance of the composition $C_{16}H_{12}O_6$, which was previously isolated, but to which no name was assigned, has also been further characterised, and designated as *chrysoeriol*, $C_{16}H_9O_3(OH)_3$ (*Journ. Chem. Soc.*, 1909, **95**, pp. 81-87).

In order to confirm the previous conclusions respecting the constitution of eriodictyol, of homo-eriodictyol, and of hesperitin (*Journ. Chem. Soc.*, 1907, **91**, pp. 887-896), these substances were methylated, when from each of them 2-hydroxy-4 : 6-dimethoxyphenyl 3 : 4-dimethoxystyryl ketone and 2 : 4 : 6-trimethoxyphenyl 3 : 4-dimethoxystyryl ketone were obtained. The last-mentioned compound was also prepared synthetically by condensing vanillin methyl ether with 2 : 4 : 6-trimethoxyacetophenone, and was found to be identical with the fully methylated product obtained from eriodictyol, homoeriodictyol, and hesperitin respectively. The evidence for the correctness of the constitutional formulæ assigned to these substances has thus been rendered complete (*Journ. Chem. Soc.*, 1910, **97**, pp. 2054-2068).

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; *Year-Book of Pharmacy*, 1904, pp. 526-541, and *Pharm. Journ.*, 1904, **73**, pp. 234-239).

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 aerial 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 $C_{13}H_{25}(OH)_2 \cdot CO_2H$ (m.p. 100-101°), which has been designated *ipurolic acid*, and a compound to which the name "ipuranol" was first assigned, but which has subsequently been found to be a phytosterol glucoside (*Amer. Journ. Pharm.*, 1908, **80**, pp. 251-286). Compare also *page* 49.

IPOMŒA HORSFALLIÆ, *Hooker*

A large, tuberous root of *Ipomœa Horsfalliæ*, Hooker, which had been obtained from Jamaica, West Indies, was subjected to a chemical examination. The root is stated to be used for the production of starch, which appears to be its chief constituent, and also for food purposes. It contains, in addition to starch, a very small proportion of resin, which was found to be devoid of physiological activity, together with sugar, a phytosterol, small amounts of fatty acids, and traces of scopoletin (*Amer. Journ. Pharm.*, 1910, **82**, pp. 355-360).

IPOMŒA ORIZABENSIS, *Ledanois*

The root of *Ipomœa orizabensis*, Ledanois, has in recent years been brought into commerce under the name of "Mexican Scammony Root," and the resin prepared therefrom has displaced to a considerable extent the true scammony resin, the two products having been generally considered to be chemically identical.

A very complete examination has been made of the above-mentioned root, and especially of its resinous constituents, which have been shown to be of a very complex character. A considerable number of well-defined compounds were obtained from the resin, either directly or after hydrolysis, and it has particularly been demonstrated that the so-called "jalapin" cannot be represented by any of the various formulæ hitherto assigned to it.

In addition to the products obtained from the resinous material, and a very small amount of an essential oil, the following constituents of the root were isolated or identified: scopoletin, $C_{10}H_8O_4$; 3:4-dihydroxycinnamic acid, $C_9H_8O_4$; sucrose and a reducing sugar (*Journ. Chem. Soc.*, 1912, **101**, pp. 1-26).

SCAMMONY ROOT AND SCAMMONY

Inasmuch as the resin of *Ipomœa orizabensis* has been presumed to be identical with the resin of scammony, which is sometimes designated "scammonin," it was deemed desirable to make a complete, comparative examination of the latter. For this purpose the resin was prepared directly from Levant scammony root, and also from the product known as virgin scammony. The results of the investigation have shown, on the one hand, that the resins obtained from scammony root and from scammony, although similar in their general characters, are not perfectly identical; on the other hand, the resin from scammony root was found to differ very considerably in composition from that of the root of *Ipomœa orizabensis.* Scammony resin, like the last-mentioned product, is of an exceedingly complex nature, but they both consist, to a large extent, of the glucosides and methylpentosides of jalapinolic acid, $C_{15}H_{30}(OH)CO_2H$, and its methyl ester (*Journ. Chem. Soc.*, 1912, **101**, pp. 398-412).

JALAP

The only constituent of jalap which is of chemical interest is the resin, and this has previously been the subject of several investigations. With consideration, however, of the recorded statements respecting the composition and characters of this resin, it was deemed desirable to subject it to a more complete examination. It has thus been shown that jalap resin is of much more complex composition than had hitherto been assumed, and that the various amorphous products previously obtained from it, to which specific names and formulæ have been assigned, such as "convolvulin," "convolvulic acid," "purgic acid," etc., were mixtures of a very indefinite nature. On the other hand, in the course of the investigation, a number of substances were obtained which permitted of definite identification or characterisation (*Journ. Amer. Chem. Soc.*, 1910, **32**, pp. 80-113).

THE FRUITS AND BARK OF BRUCEA SUMATRANA, *Roxb.*, 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; 1907, pp. 477-492, and *Pharm. Journ.*, 1903, **71**, pp. 183-189; 1907, **79**, pp. 126-130).

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; *Year-Book of Pharmacy*, 1901, pp. 349-372; *Pharm. Journ.*, 1901, **67**, pp. 258-261; 275-279, and *Amer. Journ. Pharm.*, 1913, **85**, pp. 339-344).

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 *meta*hydroxybenzaldehyde (*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, and *Pharm. Journ.*, 1902, **69**, pp. 157-159).

PRUNUS SEROTINA, *Ehrhart*

("Wild Black Cherry")

Prunus serotina, Ehrhart, is a tree which is indigenous to North America. The bark of this tree has long been used medicinally, and is recognised by both the United States and British Pharmacopœias. In contact with water, it develops benzaldehyde and hydrocyanic acid, and it has been shown that the formation of these products is due to the action of an enzyme on *l*-mandelonitrile glucoside, $C_{14}H_{17}O_6N$ (m.p. 145-147°; $[\alpha]_D - 29{\cdot}6°$). In addition to the latter compound, a number of other interesting substances have been isolated from the bark, among which may be mentioned a fluorescent principle, scopoletin, $C_{10}H_8O_4$, which was evidently present in the form of its glucoside, æsculin monomethyl ether (*Journ. Chem. Soc.*, 1909, **95**, pp. 243-261).

The leaves of *Prunus serotina* have also been subjected to a complete chemical examination, in order to compare their constituents with those of the bark. It has thus been ascertained that the leaves contain the same cyanogenetic compound as the bark, namely, *l*-mandelonitrile glucoside, but, as was anticipated, there are interesting differences with respect to the other constituents. Among the various substances isolated, in addition to the cyanogenetic glucoside, there may be mentioned hentriacontane, pentatriacontane, ceryl alcohol, a phytosterol glucoside, a new crystalline substance, $C_{31}H_{48}O{\cdot}(OH)_2$, designated as *prunol*, benzoic acid, quercetin, and a new glucoside of the latter, $C_{21}H_{20}O_{12}, 3H_2O$, which has been designated *serotrin* (*Journ. Chem. Soc.*, 1910, **97**, pp. 1099-1112).

*iso*AMYGDALIN
AND
THE RESOLUTION OF ITS HEPTA-ACETYL DERIVATIVE

*iso*Amygdalin is the name given to an optical isomeride of amygdalin, and it is obtained from the latter by treatment with dilute, aqueous alkalies. In this investigation *iso*amygdalin was acetylated, and, from the resulting product, hepta-acetylamygdalin and the hepta-acetyl derivative of the unknown isomeride were obtained, the latter isomeride having been designated *neo*amygdalin. Hepta-acetyl*neo*amygdalin (m.p. 174°; $[\alpha]_D - 65{\cdot}6°$), on hydrolysis with concentrated hydrochloric acid, yields *d*-mandelic acid, and it has thus been shown that all three varieties of mandelic acid may be obtained from amygdalin (*Journ. Chem. Soc.*, 1909, **95**, pp. 663-668).

APOCYNUM ANDROSÆMIFOLIUM, *Linné*

("Spreading Dogbane")

Apocynum androsæmifolium, Linné, is indigenous to the United States. The rhizome of this plant, as well as that of some other closely-allied species of *Apocynum*, is used to some extent medicinally. A very complete chemical study has been made of the rhizome, and this has resulted in the isolation of its chief active constituent, which has been designated *apocynamarin*, $C_{28}H_{36}O_6, 2H_2O$ (m.p. 170-175°). This substance possesses an intensely bitter taste, and is highly toxic. The rhizome has furthermore been shown to contain, amongst other substances, a considerable proportion of acetovanillone, $C_9H_{10}O_3$ (previously known as "crystalline apocynin") (m.p. 115°), the glucoside of which, $CH_3{\cdot}CO{\cdot}C_6H_3(O{\cdot}CH_3){\cdot}O{\cdot}C_6H_{11}O_5$ (m.p. 218-220°), has also been isolated, and designated *androsin* (*Journ. Chem. Soc.*, 1909, **95**, pp. 734-751).

ELATERIUM AND ELATERIN

Elaterium is defined by the British Pharmacopœia as "a sediment from the juice of the fruit of *Ecballium Elaterium*, A. Richard." An investigation of this product led to the observation that the principal crystalline constituent, known and officially recognised as "elaterin," is not homogeneous, but that it contains from 60-80 per cent. of a substance which is completely devoid of purgative action. This substance, which is lævorotatory, is accompanied in the crude elaterin by a substance of apparently the same percentage composition, but which possesses strongly purgative properties and is dextrorotatory. The constituents of the entire fresh fruit of *Ecballium Elaterium* were subsequently examined, and it was then proposed to designate the predominating constituent of crude elaterin, which is lævorotatory, as α-elaterin, and the physiologically active, dextrorotatory constituent as β-elaterin. The latter investigation also served to establish the fact that elaterin exists in the fruit in a free state, and not in the form of a glucoside, as a previous investigator had affirmed. Various products heretofore regarded as definite constituents of the fruit were likewise shown to have consisted of more or less complex mixtures (*Pharm. Journ.*, 1909, **83**, pp. 501-504; *Journ. Chem. Soc.*, 1909, **95**, pp. 1985-1993).

A further investigation of the compound designated as *α*-elaterin has shown that it possesses the formula $C_{28}H_{38}O_7$, and has also afforded some information respecting its constitution (*Journ. Chem. Soc.*, 1910, **97**, pp. 1797-1805).

COLOCYNTH

Colocynth, or the so-called "Bitter Apple," as it occurs in commerce, represents either the dried, peeled fruit, or the pulp of the fruit, of *Citrullus Colocynthis*, Schrader. Although colocynth has been the subject of several investigations, chiefly with the object of ascertaining the nature of its active constituents, no complete examination has heretofore been made of it. A recent research has shown that its activity is due to at least two principles, one of which is alkaloidal, although amorphous and a very weak base, whilst the other source of activity is represented by the ether and chloroform extracts of the resin. The colocynth contains, furthermore, a considerable proportion of *α*-elaterin, but apparently none of the physiologically active *β*-elaterin. It has, moreover, been shown that the products obtained from colocynth by previous investigators, which were designated "colocynthin," "colocynthitin," etc., do not represent pure substances, but were mixtures of a very indefinite nature, and that the amount of glucosidic substance in the fruit is extremely small. The substance to which the name "citrullol" was originally assigned has recently been shown to consist of a phytosterol glucoside (compare *page* 49).

In connection with the preceding investigation, colocynth seeds were likewise examined, the chief constituent of the latter, however, being a fatty oil (*Journ. Chem. Soc.*, 1910, **97**, pp. 99-110).

Pumpkin Seed

The seeds of the common pumpkin (*Cucurbita Pepo*, Linné) have long been recognised by the United States Pharmacopœia under the title of *Pepo*. They have been regarded as an efficient tænifuge, and, although usually administered in the form of the bruised kernels, this property has been attributed by various investigators to both the fatty oil and the resin which they contain. A complete examination of fresh pumpkin seeds has, however, failed to reveal the presence of any substance possessing marked physiological activity, and the statements regarding the efficacy of either the fatty oil or the resin, as a tænifuge, could not be confirmed. The proportion of resin is, in fact, very small. The constants and constituents of the fatty oil were determined, and from the resin a new *monocarboxylic acid* (m.p. 99°) was isolated, which agrees in composition with a hydroxycerotic acid, $C_{25}H_{51}O \cdot CO_2H$, and yields an *ethyl ester*, melting at 61° (*Journ. Amer. Chem. Soc.*, 1910, **32**, pp. 346-360).

Watermelon Seed

The seeds of the watermelon (*Cucurbita Citrullus*, Linné) appear hitherto never to have been chemically examined. The chief constituent of the seeds is a fatty oil, which has been found to agree very closely in composition with that obtained from pumpkin seed. From the resin there was isolated a new crystalline compound (m.p. 260°), which has been designated *cucurbitol* (*Journ. Amer. Chem. Soc.*, 1910, **32**, pp. 360-374).

Bryony Root

Inasmuch as the statements in the literature concerning the active constituents of bryony root were of a very indefinite and unsatisfactory character, it was deemed desirable to subject it to a more complete examination. The material employed for this purpose consisted of perfectly authentic, freshly collected roots of *Bryonia dioica*, Linné.

In the course of the investigation the following products were obtained: A small amount of a crystalline, neutral substance, which appears to possess the formula $C_{20}H_{30}O_5$; an amorphous, glucosidic product, having a brown colour and a bitter taste, which yielded on hydrolysis a brown resin and dextrose; an amorphous, alkaloidal principle, possessing a brownish-yellow colour and an intensely bitter taste; an optically inactive phytosterol; a crystalline substance termed *bryonol*, which is evidently a phytosterol glucoside; and a mixture of fatty acids. The root was also found to contain a small amount of an essential oil and a quantity of sugar, together with an enzyme which hydrolysed the above-mentioned amorphous, glucosidic constituent, and also effected the hydrolysis of amygdalin and salicin. It has been shown that the product designated by previous investigators as "bryonin" must have consisted of a complex mixture, and that the purgative property of the root resides chiefly in its resinous and alkaloidal constituents (*Journ. Chem. Soc.*, 1911, **99**, pp. 937-946).

RED CLOVER FLOWERS

The flowering tops of the common red clover (*Trifolium pratense*, Linné) have been used to some extent medicinally on account of their assumed alterative properties, but nothing of a definite nature has heretofore been known of their constituents. A recent, very complete examination of these flowers has resulted in the isolation of a large number of definite compounds, such as salicylic and *p*-coumaric acids, myricyl alcohol, heptacosane, hentriacontane, sitosterol, and *iso*rhamnetin, $C_{16}H_{12}O_7$, together with several new phenolic substances and glucosides. The substance to which the name "trifolianol" was given is evidently a phytosterol glucoside (compare *page* 49).

The flowers contain, furthermore, a little essential oil, a mixture of fatty acids, and a considerable quantity of sugar (*Journ. Chem. Soc.*, 1910, **97**, pp. 231-254).

CARNATION CLOVER FLOWERS

The flowers of the so-called "carnation clover" (*Trifolium incarnatum*, Linné) possess characters so distinct from those of the common red clover (*Trifolium pratense*, Linné) that, in order to compare their constituents with those of the last-mentioned species, they were subjected to a complete chemical examination. As was expected, some appreciable differences have thus been disclosed. They were found to contain, besides a little essential oil and a quantity of sugar, benzoic and salicylic acids in very small amount, with apparently a trace of *p*-coumaric acid; pratol, $C_{16}H_{12}O_4$; quercetin, $C_{15}H_{10}O_7$; and a new glucoside of the latter, $C_{21}H_{20}O_{12}$, $3H_2O$, which has been designated *incarnatrin*. They yielded, furthermore, an alcohol, $C_{34}H_{69}{\cdot}OH$, which had previously been obtained from the wax of the humble-bee, and is now designated *incarnatyl alcohol*; hentriacontane; a phytosterol; a phytosterol glucoside, previously designated "trifolianol"; and a mixture of fatty acids (*Journ. Chem. Soc.*, 1910, 97, pp. 1004-1015).

ORNITHOGALUM THYRSOIDES, *Jacq.*

("Chinkerinchee")

Ornithogalum thyrsoides, Jacq., is a bulbous, liliaceous plant, which is common in Cape Colony. It is reputed to be poisonous, and many deaths among horses have been attributed to it when mixed with the forage. A complete chemical examination has been made of the entire flowering plant, including the underground, bulbous portion, and the results thus obtained, in conjunction with physiological tests, have established its poisonous properties. The toxic principle appears to be chiefly contained in the resin, but, as all the extracts of the latter, with the exception of the portion removed by means of light petroleum, were physiologically active, there are probably several poisonous substances present. The attempts to obtain a definite active principle from these products were, however, unsuccessful (*Pharm. Journ.*, 1910, **84**, pp. 326-328).

LEPTANDRA

Under the title of "Leptandra" the Pharmacopœia of the United States recognises the dried rhizome and roots of *Veronica Virginica*, Linné (*Leptandra Virginica*, Nuttall), a plant which is indigenous to the greater part of North America. A complete examination of this material has resulted in the isolation of a number of compounds of chemical interest. Besides some essential oil, tannin, sugar, and resinous material, the drug was found to contain the following definite substances: *d*-mannitol; a phytosterol, $C_{27}H_{46}O$, which has been designated *verosterol*; *p*-methoxycinnamic acid, and 3 : 4-dimethoxycinnamic acid. The last-mentioned acid had not previously been observed to occur in nature. There was obtained, furthermore, a quantity of an amorphous product, which possessed an intensely bitter, nauseous taste, and which yielded on hydrolysis, besides resinous material, cinnamic and *p*-methoxycinnamic acids (*Journ. Chem. Soc.*, 1910, **97**, pp. 1944-1956).

GELSEMIUM

Gelsemium sempervirens, Aiton, or "Yellow Jessamine," is a plant indigenous to the Southern States of America, and is noted for the beauty and fragrance of its bright yellow flowers. The rhizome and roots of this plant, which are used medicinally, are recognised by several of the national Pharmacopœias, and this material has been subjected to a complete chemical examination. In the course of this investigation three alkaloidal products were obtained, one of these being the crystalline base gelsemine, which has been shown to possess the formula $C_{20}H_{22}O_2N_2$, and to melt at 178°. The other alkaloidal products, one of which corresponds to the "gelseminine" of previous investigators, were completely amorphous, and no crystalline derivatives could be obtained from them. Among other constituents of the drug, such as an essential oil, sugar, and various fatty acids, the following substances were isolated: pentatriacontane; a phytosterol, $C_{27}H_{46}O$; a phytosterolin, and traces of emodin monomethyl ether, together with scopoletin (a monomethyl ether of æsculetin). The last-mentioned compound, which was present both in the free state and in the form of a glucoside, had previously been identified as a constituent of gelsemium (*Journ. Chem. Soc.*, 1910, **97**, pp. 2223-2233).

A subsequent investigation on the constitution of scopoletin has definitely established the fact that it is 4-hydroxy-5-methoxycoumarin (*Journ. Chem. Soc.*, 1911, **99**, pp. 1043-1048), and some interesting derivatives of the alkaloid gelsemine have also been prepared (*ibid.*, 1911, **99**, pp. 1231-1240).

A method having been described in the literature for the detection of æsculin by micro-sublimation, which was regarded by its author as being specially adapted for the identification of gelsemium, the opportunity was taken of correcting several errors of statement connected therewith. It has particularly been noted that gelsemium contains no æsculin, and, furthermore, that this glucoside cannot be sublimed, owing to its decomposition on heating. The crystalline sublimate obtained from gelsemium under the specified conditions consists of scopoletin (*Pharm. Journ.*, 1912, **88**, p. 157).

IRIS VERSICOLOR, *Linné*

("Larger Blue Flag")

The rhizome and roots of *Iris versicolor*, Linné, have been employed to some extent medicinally, especially in the form of preparations consisting either of resinous products or extracts of the drug. Although in the fresh state the drug evidently possesses considerable potency, its activity becomes impaired by age.

An examination of commercial "Blue Flag Root" showed it to contain, besides some essential oil, tannin, and sugar, a small amount of *iso*phthalic acid, $C_6H_4(CO_2H)_2$, the latter compound not having previously been observed to occur in nature. From the resinous material the following definite substances were isolated : a phytosterol, $C_{27}H_{46}O$; a phytosterol glucoside ; myricyl alcohol ; heptacosane ; and a mixture of fatty acids. No marked physiological activity was exhibited by any of the products obtained from the drug (*Amer. Journ. Pharm.*, 1911, 83, pp. 1-14).

LASIOSIPHON MEISSNERIANUS, *Endl.*

Lasiosiphon Meissnerianus, Endl. (Nat. Ord. *Thymelacaceæ*), is a shrub indigenous to South Africa, where the root is stated to be used as a cure for snake-bite. The chief constituent of the root is an amorphous, acrid resin, from which only a phytosterol, $C_{27}H_{46}O$, and a mixture of fatty acids could be obtained (*Amer. Journ. Pharm.*, 1911, 83, pp. 49-55).

WITHANIA SOMNIFERA, *Dunal*

Withania somnifera, Dunal, is a solanaceous plant which occurs in South Africa and on the west coast of India, and is also said to be common along the shores of the Mediterranean. As the specific name of the plant implies, it has been considered to possess sedative and hypnotic properties. The material employed for investigation was obtained from South Africa, and consisted of both the root and the overground portion of the plant, which were separately examined. The root was found to contain a small amount of an essential oil and a quantity of sugar, and from the resinous material the following definite substances were isolated : hentriacontane ; a phytosterol ; a phytosterol glucoside ; a mixture of fatty acids ; a new monohydric alcohol, *withaniol*, $C_{25}H_{33}O_4 \cdot OH$; and an amorphous, alkaloidal principle, which, on treatment with alkalis, yielded a crystalline base, $C_{12}H_{16}N_2$. The leaves and stems of the plant yielded a number of substances which had also been obtained from the root, and, in addition thereto, a new monohydric alcohol, somnirol, $C_{32}H_{43}O_6 \cdot OH$; a new dihydric alcohol, somnitol, $C_{33}H_{44}O_5\ (OH)_2$; and an acidic hydrolytic product, *withanic* *acid,* $C_{29}H_{45}O_6 \cdot CO_2H$. The plant was found to contain no mydriatic alkaloid, and the physiological properties which have been attributed to it could not be confirmed (*Journ. Chem. Soc.,* 1911, **99**, pp. 490-507).

RHUBARB

Although rhubarb has frequently engaged the attention of chemists, it was deemed desirable to subject it to a more complete examination, especially as much confusion has existed in the literature with respect to its constituents. The material employed for the investigation consisted of the best quality of sun-dried "Shensi" rhubarb.

The drug was found to contain a small amount of an essential oil, to which its characteristic odour is due, and among the large number of other constituents the following more important compounds may be noted: rhein; emodin; aloe-emodin; emodin monomethyl ether; chrysophanic acid, and a crystalline mixture of glucosides of these substances; a new anthraquinone derivative, $C_{17}H_{10}O_6$, which has been designated *rheinolic acid;* cinnamic acid; gallic acid; a trace of a substance subsequently identified as ellagic acid; a mixture of fatty acids; tannin; dextrose and lævulose; a phytosterol, $C_{27}H_{46}O$; and an amorphous, non-glucosidic resin, which, on hydrolysis, yielded several of the above-mentioned substances, together with a new compound, $C_{14}H_{12}O_3$.

Of the anthraquinone derivatives, only aloe-emodin and chrysophanic acid had a purgative action, the mixture of glucosides being quite inert. The chief purgative principle of the drug is the above-mentioned non-glucosidic resin (*Journ. Chem. Soc.,* 1911, **99**, pp. 946-967).

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).

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).

RUMEX ECKLONIANUS, *Meisner*

Rumex Ecklonianus, Meisner, a plant belonging to the family of *Polygonaceæ*, is indigenous to South Africa, where it is reputed to possess medicinal properties. A complete chemical examination has been made of the entire overground portion of the plant, which resulted in the isolation, amongst other substances, of several anthraquinone derivatives. In the course of this investigation the *dimethyl ether of chrysophanic acid*, $C_{17}H_{14}O_4$, was prepared. The latter compound crystallises in yellow prisms, melting at 190° (*Journ. Chem. Soc.*, 1910, **97**, pp. 1-11).

SENNA LEAVES

Although senna leaves have in the past been the subject of numerous investigations, little has been known until recently respecting the definite compounds present in them. Some statements concerning the occurrence of particular substances in these leaves cannot be confirmed, while, on the other hand, certain products to which distinctive names had been assigned have been shown to consist of indefinite mixtures.

The material employed for investigation consisted of (i) Tinnevelly senna leaves; (ii) Senna leaves from Peru, which were found to be botanically identical with the Tinnevelly leaves; and (iii) Alexandrian senna leaves.

The Tinnevelly leaves yielded a small amount of an essential oil; salicylic acid; rhein, $C_{15}H_8O_6$; kaempferol, $C_{15}H_{10}O_6$; aloe-emodin, $C_{15}H_{10}O_5$; *kaempferin*, $C_{27}H_{30}O_{16},6H_2O$, a new glucoside of kaempferol; a mixture of the glucosides of rhein and aloe-emodin; the magnesium salt of an unidentified organic acid; myricyl alcohol; a phytosterol, $C_{27}H_{46}O$; a phytosterol glucoside, $C_{33}H_{56}O_6$; and palmitic and stearic acids. The leaves also contained a quantity of sugar, together with some amorphous, glucosidic material.

The senna leaves from Peru were found to contain all the above-mentioned compounds, with the exception of the magnesium salt, and, in addition, *iso*rhamnetin.

Alexandrian senna leaves yielded, in addition to myricyl alcohol and a phytosterol glucoside, rhein, aloe-emodin, kaempferol, and *iso*rhamnetin. The four last-mentioned substances were also present in the form of glucosides, and in much larger proportion as such than in the free state (*Journ. Chem. Soc.*, 1913, **103**, pp. 2006-2023).

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).

A more recent investigation of the constituents of commercial chrysarobin has shown that the latter is a variable product, and more complicated in its nature than was heretofore supposed. Two new compounds have been isolated from it, namely, the monomethyl ether of dehydroemodinanthranol, $C_{16}H_{12}O_4$, and a substance designated *ararobinol*, $C_{23}H_{16}O_5$, while certain products previously described as individual substances have been shown to be mixtures (*Journ. Chem. Soc.*, 1912, **101**, pp. 290-304).

In order to ascertain whether aloes contain any anthraquinone derivatives other than aloe-emodin, the variety known as Curaçao aloes was examined, but no such compounds were found. In addition to aloe-emodin, the following products were obtained: a fatty acid (m.p. 75-78°); cinnamic and *p*-coumaric acids, with apparently a trace of salicylic acid; and a small amount of glucosidic material (*Pharm. Journ.*, 1913, **91**, p. 836).

OENANTHE CROCATA, *Linné*

The umbelliferous plant, *Oenanthe crocata*, Linné, has frequently attracted attention on account of the poisonous properties of its roots, but nothing of a very definite character had hitherto been known concerning its constituents. The material examined consisted of the entire plants, which had been collected on the banks of the Thames, at Kew. It contained no alkaloid. The constituents of the plant, besides considerable amounts of cane sugar, dextrose and lævulose, were found to comprise an essential oil; a colourless, crystalline substance (m.p. 83°), which, on keeping, assumed a purple colour; salicylic acid; triacontane; hentriacontane; a phytosterol; a phytosterol glucoside; a mixture of fatty acids; and resinous material. The neutral portions of the petroleum and ether extracts of the resin represent the toxic principle of the plant (*Pharm. Journ.*, 1911, **87**, pp. 296-298).

THE SEEDS OF CASIMIROA EDULIS

Casimiroa edulis, La Llave and Lejarza (Nat. Ord. *Rutaceæ*), is a tree which is widely distributed throughout Mexico and Central America. The fruit and the seed of this tree are recognised by the Pharmacopœia of Mexico under the title of "Zapote blanco." The fruit, as the specific name of the plant denotes, is edible, although stated to induce sleep, whereas the kernels of the seed have been regarded as deleterious or even fatal in their effects. For the purpose of investigation, a quantity of the seed was freshly collected in Mexico. They were found to contain a number of interesting compounds, among which may be noted two new, crystalline alkaloids, one of the latter having been designated *casimiroine*, $C_{24}H_{20}O_8N_2$, and the other *casimiroedine*, $C_{17}H_{24}O_5N_2$. Other constituents of the seeds, besides an essential oil, an enzyme which hydrolysed amygdalin, and a quantity of sugar, comprised the following substances: benzoic acid; sitosterol, $C_{27}H_{46}O$; a phytosterol glucoside; a mixture of fatty acids; a yellow, phenolic substance, $C_{16}H_{12}O_6$; and a new lactone, *casimirolid*, $C_{24}H_{28}O_6$, which yielded a new hydroxy-acid, designated as *casimiroic acid*, $C_{23}H_{28}O_4(OH){\cdot}CO_2H$. The reputed hypnotic or toxic properties of the seed could not be confirmed (*Journ. Chem. Soc.*, 1911, **99**, pp. 1993-2010).

BUPHANE DISTICHA, *Herb.*

Buphane disticha, Herb., is a bulbous plant belonging to the *Amaryllidaceæ*, and is a native of South Africa, where it is known as the "poison bulb," or, to the Dutch, as "gift-bol." It is a frequent, although nowhere abundant, object in the Veldt. The plant is stated to have been used as an arrow-poison, and in the treatment of the disease known as "red-water." Although long known to possess toxic properties, it does not appear to have previously been chemically examined.

An investigation of the inner portion of the bulbs of the plant showed them to contain a mixture of alkaloids, the principal constituent of which is an amorphous, strongly basic product, designated *buphanine,* which possesses a physiological action similar to that of hyoscine. A weakly basic and a water-soluble alkaloid were also obtained, together with a small amount of narcissine, $C_{16}H_{17}O_4N$. The weakly basic alkaloid is a convulsant poison, while the base soluble in water resembles colchicine and narcissine in its physiological action.

In addition to the above-mentioned substances, the bulbs were found to contain an essential oil; acetovanillone; pentatriacontane; a phytosterol; a phytosterol glucoside; a mixture of fatty acids; chelidonic acid; and considerable amounts of lævulose and copper (*Journ. Chem. Soc.*, 1911, **99**, pp. 1240-1248).

CLUYTIA SIMILIS, *Muell. Arg.*

Cluytia similis, Muell. Arg., is a plant belonging to the family of *Euphorbiaceæ,* and is indigenous to South Africa. It is reputed in its native country to be of value as an antidote for anthrax and for the disinfection of anthrax-infected meat, while the root is stated to be eaten by some of the natives as an antidote for snake-bite poisoning.

For the purpose of investigation, a quantity of the entire overground portion of the plant was specially collected in South Africa. This material yielded, besides a small amount of an essential oil and a quantity of sugar and potassium chloride, a number of definite substances, including several new compounds. There were isolated: chrysophanol; a new *acid,* $C_{10}H_{10}O_4$; fumaric acid; *cluytinic acid,* $C_{21}H_{42}O_2$; *cluytyl alcohol,* $C_{28}H_{58}O$; *cluytyl cluytinate,* $C_{49}H_{98}O_2$; *cluytiasterol,* $C_{27}H_{44}O$; triacontane; a mixture of fatty acids; a substance designated "cluytianol," which apparently is a phytosterol glucoside; and a compound $C_{14}H_{10}O_5$, which is probably a trihydroxydihydroanthraquinone (*Journ. Chem. Soc.*, 1912, **101**, pp. 2221-2234).

TARAXACUM ROOT

The root of the common dandelion (*Taraxacum officinale,* Wiggers) has been employed medicinally for several centuries, but, until recently, little was known respecting its constituents. The material employed for investigation consisted of the best quality of freshly collected English taraxacum root. A complete examination of this material showed it to contain, besides a small amount of essential oil, an enzyme, and a quantity of a lævorotatory sugar, which was probably lævulose, the following definite compounds: choline, $C_5H_{15}O_2N$; *p*-hydroxyphenylacetic acid, $C_8H_8O_3$; 3:4-dihydroxycinnamic acid, $C_9H_8O_4$; a mixture of fatty acids; two new monohydric alcohols, *taraxasterol*, $C_{29}H_{47}\cdot OH$, and *homotaraxasterol*, $C_{25}H_{39}\cdot OH$; and a substance which had been designated "cluytianol" (*see Cluytia similis, page* 41), but which apparently is a phytosterol glucoside.

The bitter taste of taraxacum appears to be due chiefly to dark-coloured, amorphous material, and not to any distinct principle, as had previously been assumed (*Journ. Chem. Soc.*, 1912, **101**, pp. 2411-2429).

THE BARK OF ERYTHROPHLŒUM GUINEENSE, *G. Don*

Erythrophlœum Guineense, G. Don, is a tree indigenous to Central and Western Africa. The bark of this tree, which is known by several common names, such as "sassy bark," "casca bark," "doom bark," and in the vernacular of the Congo as "Nkasa," was brought to notice many years ago on account of its intensely poisonous properties. It has been employed by the natives of Western Africa as an ordeal in their trials for witchcraft and sorcery, as well as for other criminal purposes, and apparently also enters into the composition of the arrow-poison of the Pigmies.

A chemical examination of the bark resulted in the isolation of several well-known compounds, and the presence of a highly toxic alkaloid, designated by previous investigators as *erythrophleine*, was confirmed. Neither this alkaloid nor its salts could, however, be obtained in a crystalline state (*Amer. Journ. Pharm.*, 1912, **84**, pp. 337-351).

JAMBUL SEEDS

The so-called Jambul seeds are obtained from *Eugenia Jambolana*, Lam., a tree belonging to the family of

Myrtaceæ, and indigenous to the East Indies. Various parts of the tree, such as the fruit, leaves, and bark, have been employed medicinally on account of their astringent properties, but the seeds have been more prominently brought to notice in recent years as a suggested remedy in the treatment of diabetes.

An examination of a quantity of authentic Jambul seeds, obtained directly from India, showed them to contain a small amount of an essential oil ; a mixture of fatty acids ; considerable amounts of tannic and gallic acids ; and a reducing sugar, together with a substance which was originally designated as "jambulol," and to which the formula $C_{16}H_3O_4(OH)_5$ was assigned. A subsequent, more complete examination of the latter substance has, however, proved it to be identical with the so-called ellagic acid, $C_{14}H_2O_4(OH)_4$ (*Pharm. Journ.*, 1912, **88**, pp. 414-417 ; 1913, **91**, p. 245).

EUONYMUS ATROPURPUREUS, *Jacquin*

Euonymus atropurpureus, Jacquin, is a shrub belonging to the family of *Celastraceæ*, and indigenous to North America, where it is known by the common names of "wahoo" and "burning bush." The root-bark of the plant is used medicinally, and is recognised by both the United States and British Pharmacopœias.

A complete examination of this bark resulted in the isolation of a number of interesting compounds. Besides an essential oil, sugar, tannin, a mixture of fatty acids, and small amounts of other substances, it was found to contain a considerable quantity of dulcitol, the latter being a previously known constituent, and a new acid, $C_5H_4O_3$, which is evidently *furan-β-carboxylic acid*. Furthermore, four new crystalline alcohols were obtained, which were designated respectively : *euonymol*, $C_{21}H_{30}O_4$; *euonysterol*, $C_{31}H_{51}O{\cdot}OH$; *homoeuonysterol*, $C_{40}H_{69}O{\cdot}OH$; and *atropurol*, $C_{27}H_{44}(OH)_2$. No evidence could be obtained of the presence of an active glucosidic substance in the bark, as had previously been affirmed (*Journ. Chem. Soc.*, 1912, **101**, pp. 1040-1052). The very small amount of substance designated as "citrullol" (*see* Colocynth, *page* 29) has, however, since been shown to consist of a phytosterol glucoside (compare *page* 49).

CALABAR BEANS

The so-called Calabar beans, which represent the ripe seed of *Physostigma venenosum*, Balfour, have hitherto been the subject of several investigations, and their most important constituent is the alkaloid physostigmine or eserine. In connection with the preparation of a quantity of this alkaloid for the purpose of a separate investigation, it was deemed desirable to examine more completely the other constituents of the seed.

The alkaloid physostigmine, $C_{15}H_{21}O_2N_3$, has been found to be dimorphous, since two modifications were obtained, melting at 86-87° and 105-106° respectively. In addition to the previously known eseramine, a new alkaloid was isolated, which possesses the formula $C_{14}H_{18}O_3N_2$, and has been designated *physovenine*. Other constituents of the seed comprise, besides the previously isolated stigmasterol, $C_{30}H_{48}O$, and sitosterol, $C_{27}H_{46}O$, the substances designated as "calabarol" and "trifolianol" (*see* Red Clover Flowers, *page* 31), which are probably phytosterol glucosides; a mixture of fatty acids; sugar; and resinous material (*Journ. Chem. Soc.*, 1911, **99**, pp. 2148-2159).

As little had been known regarding the constitution of physostigmine, an investigation was undertaken for the purpose of elucidating the subject. Although it is not yet possible to assign to this alkaloid a constitutional formula, considerable information has been obtained respecting the structure of the molecule (*Journ. Chem. Soc.*, 1912, **101**, pp. 978-989; 1913, **103**, pp. 351-361, 1988-1995).

ANONA MURICATA, *Linné*

("Soursop")

The leaves of *Anona muricata*, Linné (Nat. Ord. *Anonaceæ*), are reputed to possess medicinal properties which render them useful in fever, nervousness, etc., and they are also said to be used as an anthelmintic.

The material for their investigation was obtained from Dominica, W.I.

A complete examination of the leaves has shown them to contain a small amount of an essential oil; an alkaloidal substance, which could not be crystallised; myricyl alcohol; sitosterol, $C_{27}H_{46}O$; a substance designated "anonol," which is probably a phytosterol glucoside; a mixture of fatty acids; and considerable potassium chloride, together with dextrose, tannin, and amorphous products *(Pharm. Journ.*, 1911, **87**, pp. 743-745).

CAULOPHYLLUM THALICTROIDES *(Linné)*, *Michaux*

Caulophyllum thalictroides (Linné), Michaux, is a plant belonging to the family of *Berberidaceæ*, and is indigenous to North America. The rhizome and roots of the plant have been employed to some extent medicinally, but the information which had hitherto been recorded respecting the constituents of the drug was of a rather fragmentary and indefinite nature. A quantity of perfectly authentic material was therefore subjected to a complete examination, which resulted in the isolation of the following compounds: methylcytisine, $C_{12}H_{16}ON_2$; two crystalline glucosides, *caulosaponin*, $C_{54}H_{88}O_{17}$, $4H_2O$, and *caulophyllosaponin*, $C_{66}H_{104}O_{17}$; a phytosterol, $C_{27}H_{46}O$; a substance to which the name "citrullol" had previously been assigned (*see* Colocynth, *page* 29), but which is evidently a phytosterol glucoside; and a mixture of fatty acids. The drug was found to contain, furthermore, a small amount of an essential oil, an enzyme, and a quantity of a reducing sugar, together with a comparatively small amount of resinous material *(Journ. Chem. Soc.*, 1913, **103**, pp. 191-209).

HOPS

On account of the extended use of hops in the brewing industry, and also, but in a very much less degree, for medicinal purposes, they have been the subject of numerous investigations. The chief object of these investigations appears to have been to ascertain the nature of the bitter principles, or to determine the proportion in which they are present. Nevertheless, apart from the essential oil yielded by the distillation of hops with steam, the determination of the presence of tannin, sugar, potassium nitrate, and the isolation of a small amount of choline, very little of a definite nature had hitherto been known respecting their constituents.

A recent investigation has revealed the presence in hops of a considerable number of previously unknown constituents, including some new compounds, and has also served to indicate the indefinite character of some of the products described in the literature. In addition to the above-mentioned substances, the previously recorded occurrence of asparagine and an exceedingly small amount of a volatile base has been confirmed, and the following definite compounds were isolated from the resinous material: ceryl alcohol, $C_{27}H_{56}O$; hentriacontane, $C_{31}H_{64}$; a phytosterol, $C_{27}H_{46}O$; a phytosterol glucoside, $C_{33}H_{56}O_6$; a mixture of volatile fatty acids, consisting of formic, acetic, butyric, valeric, and β-*iso*propylacrylic acids, with apparently a little nonoic acid, $C_9H_{18}O_2$; saturated and unsaturated non-volatile acids, comprising palmitic, stearic, and cerotic acids, an acid $C_{20}H_{40}O_2$, which is apparently an isomeride of arachidic acid, cluytinic-acid, $C_{21}H_{42}O_2$, and linolic acid; a new, crystalline phenolic substance, *humulol*, $C_{17}H_{18}O_4$, which possesses a bitter taste; and a new, crystalline, phenolic substance, *xanthohumol*, $C_{13}H_{14}O_3$, which is tasteless, and possesses an orange-yellow colour. The amount of resinous material was equivalent to about 14·1 per cent. of the weight of hops employed.

It was ascertained that the bitterness of hops is not due to any single substance, but is to be attributed to a number of products, most of which are amorphous. Some of these products are soluble in water, while others represent constituents of the resin, and among the latter is the above-mentioned humulol. The aroma of hops is due entirely to the essential oil (*Journ. Chem. Soc.*, 1913, **103**, pp. 1267-1292).

DICOMA ANOMALA, *Sonder*

Dicoma anomala, Sonder, is a small composite plant, which is known in South Africa by the Kaffir name of *in-nyongwane*, and is reputed to possess medicinal value. It had not hitherto been subjected to a chemical examination, and the material employed for this purpose consisted of the entire, air-dried plant, which had been specially collected in South Africa.

Among the constituents of the plant, besides a small amount of an essential oil and a quantity of a reducing sugar, the following products may be noted: a small amount of a colourless, crystalline glucoside, which appeared to possess the formula $C_{39}H_{58}O_{17}$; a quantity of a yellow, amorphous product, which, on hydrolysis with alkali, gave 3 : 4-dihydroxycinnamic acid; a small amount of an amorphous alkaloid; hentriacontane, $C_{31}H_{64}$; a phytosterol, $C_{28}H_{46}O$; and a mixture of fatty acids, the unsaturated portion of which appeared to consist chiefly of a compound, $C_{16}H_{30}O_2$, such as has been obtained from cod liver oil. The air-dried plant contained about 6 per cent. of resinous material, from which a number of the above-mentioned substances were isolated (*Pharm. Journ.*, 1913, **90**, pp. 694-696).

EUPHORBIA PILULIFERA, *Linné*
(" Queensland Asthma Herb ")

Euphorbia pilulifera, Linné (Nat. Ord. *Euphorbiaceæ*), is an annual, herbaceous plant, which occurs in nearly all tropical countries. It has attracted considerable attention in recent years on account of its reputed value in the treatment of asthma, bronchitis, and other diseases of the respiratory organs. The material employed for its investigation consisted of the freshly-collected, air-dried plant, which was obtained directly from the Fiji Islands.

The plant was found to contain a small amount of an essential oil, a quantity of amorphous, glucosidic material, together with a lævorotatory sugar, and an exceedingly small amount of alkaloidal substance, which could not be further characterised. In addition thereto, the following more definite compounds were isolated: gallic acid; quercetin, $C_{15}H_{10}O_7$; a new *phenolic substance*, $C_{28}H_{18}O_{15}$; triacontane, $C_{30}H_{62}$; a new monohydric alcohol, *euphosterol*, $C_{25}H_{39}\cdot OH$; a phytosterol; a phytosterol glucoside; melissic and other fatty acids; and a small amount of substance designated as "jambulol" (*see* Jambul Seeds, *page* 42), which has since been found to be identical with ellagic acid (*Pharm. Journ.*, 1913, **90**, pp. 506-510).

PHASEOLUS MULTIFLORUS, *Lam.*

(" Scarlet Runner Bean ")

The scarlet runner bean (*Phaseolus multiflorus*, Lam.) is a well-known and largely used culinary vegetable, but a statement occurs in the literature that the roots of the plant are narcotic and poisonous. It therefore seemed desirable to ascertain whether this statement could be confirmed by means of a chemical examination and physiological tests. For this purpose a quantity of roots were obtained from plants cultivated at Dartford, Kent.

In the course of the investigation the following products were isolated: an enzyme which hydrolysed amygdalin; a small amount of an essential oil; furan-β-carboxylic acid, $C_5H_4O_3$; allantoin, $C_4H_6O_3N_4$; a phytosterol, $C_{27}H_{46}O$; small amounts of substances consisting apparently of a phytosterol glucoside and pentatriacontane; a new, crystalline glucoside, *phaseosaponin*, $C_{50}H_{84}O_{20}$; and a mixture of fatty acids. The roots also contained some resin and amorphous glucosidic material, and a quantity of a reducing sugar. No alkaloid was present, nor could any trace of a compound capable of yielding hydrogen cyanide be detected.

Physiological tests, in conjunction with the results of the chemical examination, afforded no evidence that the roots of the scarlet runner bean, as obtained from cultivated plants, possess the toxic properties ascribed to them. Whether the plants in a wild state, or cultivated in a tropical climate, may produce roots which exhibit poisonous properties, is at present undetermined (*Pharm. Journ.*, 1913, **90**, pp. 550-552).

WHEAT GERM

The material known as wheat germ was formerly a waste product of the flour mills, or used only as fodder, but in recent years it has been utilised in the manufacture of certain kinds of bread and in various other foods.

Inasmuch as a considerable quantity of a definite phytosterol was required for synthetic purposes, and the best source of this compound being the wheat germ, it was deemed desirable, incidentally, to subject the latter to a complete chemical examination.

Previous investigators had shown this material to contain choline, betaine, allantoin, cane sugar, dextrose and raffinose, and the occurrence of all these substances has been confirmed. In addition thereto, the fatty oil has been more completely examined, and the acids, contained chiefly therein as glycerides, have been found to consist of palmitic, stearic, and linolic acids, the latter predominating. A very small amount of sinapic acid, $C_{11}H_{12}O_5$, was also obtained, which probably exists in the wheat germ in the form of sinapine, the latter being a choline ester of sinapic acid. The material yielded, furthermore, a small amount of an amorphous, glucosidic product, but the proportion of resinous substances was exceedingly small (*Pharm. Journ.*, 1913, **91**, pp. 117-120, and *Year-Book of Pharmacy*, 1913, pp. 456-466).

THE SYNTHETICAL PREPARATION OF THE *d*-GLUCOSIDES OF SITOSTEROL, CHOLESTEROL, AND SOME FATTY ALCOHOLS

It has recently been shown that phytosterol glucosides are widely distributed in plants. A considerable number of such compounds have been isolated in the course of investigations in these laboratories, and, having first been regarded as dihydric alcohols, which differed somewhat in composition and character according to their source, they were given distinctive names, such as "ipuranol," "citrullol," "trifolianol," "ipurganol," etc., but are now collectively designated as *phytosterolins*.

In order to obtain further information regarding these naturally occurring substances, and to compare their properties with those of a typical phytosterol glucoside, it was deemed desirable to undertake the preparation of the latter by synthetical means. For this purpose the definite phytosterol obtained from wheat germ, and known as sitosterol, $C_{27}H_{46}O$, was employed. The glucoside thus obtained was found to possess properties closely resembling the phytosterolins. In addition to the synthesis of sitosterol-*d*-glucoside, the glucosides of cholesterol, myricyl alcohol, ceryl alcohol, and cetyl alcohol have been prepared (*Journ. Chem. Soc.*, 1913, **103**, pp. 399-406 and 1022-1029).

SARSAPARILLA ROOT

Although sarsaparilla root has heretofore been the subject of a number of investigations, much confusion has existed respecting its constituents, especially those of a glucosidic nature.

A recent, complete examination of commercial grey Jamaica sarsaparilla root (from *Smilax ornata*, Hooker, fil.) has shown it to contain but one definite saponin glucoside, possessing the formula $C_{44}H_{76}O_{20}, 7H_2O$, for which the name sarsasaponin is retained. It is accompanied, however, in the root by sitosterol-*d*-glucoside (phytosterolin), $C_{33}H_{56}O_6$. In addition to these substances, a small amount of an essential oil and an enzyme, the following constituents of the root were isolated or identified: sitosterol, $C_{27}H_{46}O$; stigmasterol, $C_{30}H_{50}O$; a new, crystalline, dicarboxylic acid, *sarsapic acid*, $C_4H_2O_2(CO_2H)_2$; dextrose; a mixture of fatty acids; and a considerable quantity of potassium nitrate (*Journ. Chem. Soc.*, 1914, **105**, pp. 201-219).

SOLANUM ANGUSTIFOLIUM, *Ruiz and Pavon.*

("Duraznillo Blanco")

This solanaceous plant occurs in different parts of South America, where it is employed as a febrifuge, chiefly in the treatment of enteric fever, but also in cases of malaria. The material for its investigation was obtained from Lima, Peru, and consisted of the leaves, twigs and flowers of the plant.

A complete examination of the above-mentioned material led to the isolation of a number of compounds, amongst which may specially be noted a new gluco-alkaloid. The latter substance, designated *solangustine*, $C_{33}H_{53}O_7N$, H_2O, yields, on hydrolysis, *solangustidine*, $C_{27}H_{43}O_2N$, and dextrose. Other constituents of the plant which were isolated or identified comprise the following compounds : quercetin ; rutin, $C_{27}H_{30}O_{16}$, $3H_2O$; asparagine ; triacontane, $C_{30}H_{62}$; a phytosterol, $C_{27}H_{46}O$; a phytosterol glucoside, $C_{33}H_{56}O_6$; and a mixture of fatty acids. Some amorphous alkaloidal material was also present, together with a quantity of sugar, which apparently was lævulose.

Although the plant is reputed to be poisonous, neither an alcoholic extract of it nor the gluco-alkaloid, solangustine, produced any perceptible physiological effect when administered to dogs (*Journ. Chem. Soc.*, 1914, **105**, pp. 559-576).

DAVIESIA LATIFOLIA, *R. Br.*

The leguminous shrub, *Daviesia latifolia*, R. Br., is indigenous to Victoria, Australia, but is also said to occur in parts of Tasmania and New South Wales. In the districts where it grows it is known as the "Native Hop Bush," a designation which is supposed to have been given it on account of the bitter taste of the leaves.

The bitterness of the plant has been shown to be due to a crystalline benzoyl derivative of a new disaccharide, the latter containing both a dextrose and a xylose complex. This crystalline compound, which possesses the formula $C_{25}H_{28}O_{12}$, H_2O, or which may be expressed as $C_{11}H_{18}O_{10}(CO \cdot C_6H_5)_2$, H_2O, has been designated *dibenzoyl-glucoxylose*, and it represents a type of compound which has hitherto not been observed to occur in nature.

In the course of the investigation the following additional constituents of the plant were isolated : an essential oil ;

benzoic, salicylic, *p*-coumaric, and fumaric acids; a mixture of fatty acids; a quercetin glucoside, $C_{27}H_{30}O_{16}$, which is probably rutin; myricyl alcohol; hentriacontane; and a phytosterol, $C_{27}H_{46}O$. A quantity of a reducing sugar was also present, together with resinous material, and from the latter some of the above-mentioned compounds were obtained (*Journ. Chem. Soc.*, 1914, **105**, pp. 767-778 and 1062-1069).

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, and *Pharm. Journ.*, 1901, **67**, pp. 147-150). 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 clearly defined, and a reliable method devised for the determination of their purity (*Year-Book of Pharmacy*, 1898, pp. 409-423, and *Pharm. Journ.*, 1898, **61**, pp. 171-176).

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, and *Pharm. Journ.*, 1901, **67**, pp. 135-137).

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 (*Year-Book of Pharmacy*, 1908, pp. 507-513, and *Pharm. Journ.*, 1908, **81**, pp. 342-344).

Some new preparations of Bismuth have also been formed which are specially adapted for medicinal use. These comprise: (1) *Soluble Bismuth Tartrate*, which is characterised by its complete stability and the property of dissolving readily and completely in water, yielding a bright, slightly acid 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* was also undertaken, and the first part of this work, treating of the poplars, has been published (*Year-Book of Pharmacy*, 1903, pp. 442-479, and *Pharm. Journ.*, 1903, **71**, pp. 171-182).

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 that 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 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.

LIST OF SPECIMENS EXHIBITED

I. CHEMICAL PREPARATIONS

SALTS OF THE ALKALOIDS OF JABORANDI LEAVES

Pilocarpine Nitrate
*iso*Pilocarpine Nitrate
*iso*Pilocarpine Picrate

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

DERIVATIVES OF TROPINE AND ψ-TROPINE

Tropine *d*-Camphorsulphonate
Benzoyltropeine *d*-Camphorsulphonate
Benzoyltropeine Picrate
ψ-Tropine *d*-Bromocamphorsulphonate
Benzoyl-ψ-tropeine *d*-Camphorsulphonate
Benzoyl-ψ-tropeine *d*-Bromocamphorsulphonate
Benzoyl-ψ-tropeine Picrate
Tropinone *d*-Camphorsulphonate

SALTS OF THE STEREOISOMERIC HYOSCYAMINES

d-Hyoscyamine *d*-Camphorsulphonate
d-Hyoscyamine Aurichloride
d-Hyoscyamine Auribromide
l-Hyoscyamine *d*-Camphorsulphonate
l-Hyoscyamine Aurichloride
l-Hyoscyamine Auribromide

Some Substituted Pyrazines and their Salts

2 : 5-Diphenylpyrazine (Untreated with Permanganate)
2 : 5-Diphenylpyrazine (Treated with Permanganate)
2 : 5-Diphenylpyrazine Dihydrobromide
2 : 6-Diphenylpyrazine
2 : 6-Diphenylpyrazine Monohydrochloride
2 : 6-Diphenylpyrazine Monohydrobromide
pp'-Dimethoxy-2 : 5-diphenylpyrazine
pp'-Dimethoxy-2 : 5-diphenylpyrazine Monosulphate
pp'-Dimethoxy-2 : 5-diphenylpyrazine Disulphate
pp -Dimethoxy-2 : 6-diphenylpyrazine
pp'-Dimethoxy-2 : 6-diphenylpyrazine Monohydrochloride
pp'-Dimethoxy-2 : 6-diphenylpyrazine Monohydrobromide
mm'pp -Tetramethoxy-2 : 5-diphenylpyrazine
mm'pp'-Tetramethoxy-2 : 5-diphenylpyrazine Disulphate
mm'pp'-Tetramethoxy-2 : 6-diphenylpyrazine
mm'pp'-Tetramethoxy-2 : 6-diphenylpyrazine Monohydrochloride

Substances obtained during the Synthesis of Compounds Related to Epinephrine

Red Base from *ω*-Chloroacetophenone and Ammonia
Hydrochloride of Red Base
ω-Amino-*p*-hydroxyacetophenone
ω-Amino-*p*-hydroxyacetophenone Hydrochloride
ω-Amino-*p*-hydroxyacetophenone Hydriodide
Tribenzoyl-*β*-*p*-dihydroxy-*β*-phenylethylamine
ω-Amino-*p*-methoxyacetophenone Hydrochloride
ω-Amino-*p*-methoxyacetophenone Platinichloride
ω-Amino-*p*-methoxyacetophenone Aurichloride
ω-Amino-*p*-methoxyacetophenone Picrate
ω-Chloro-*o*-hydroxyacetophenone
ω-Chloro-*o*-methoxyacetophenone
ω-Phthalimino-*o*-methoxyacetophenone
ω-Amino-*o*-hydroxyacetophenone Hydriodide
oo'-Dihydroxy-2 : 5-diphenylpyrazine
ω-Chloro-*op*-dimethoxyacetophenone
ω-Phthalimino-*op*-dimethoxyacetophenone
ω-Phthalimino-*op*-dihydroxyacetophenone
ω-Amino-*op*-dihydroxyacetophenone
ω-Amino-*op*-dihydroxyacetophenone Hydrochloride
ω-Amino-*op*-dihydroxyacetophenone Hydriodide
ω-Amino-*op*-dihydroxyacetophenone Platinichloride

ω-Amino-*op*-dihydroxyacetophenone Aurichloride
ω-Amino-*op*-dihydroxyacetophenone Picrate
N-Benzoyl-ω-amino-*op*-dihydroxyacetophenone
ω-Chloro-*mp*-dimethoxyacetophenone
ω-Amino-*mp*-dihydroxyacetophenone
ω-Amino-*mp*-dihydroxyacetophenone Hydriodide
Diphenacylamine Hydrochloride
Diphenacylamine Hydriodide
pp′-Dihydroxydiphenacylamine Hydrochloride
pp′-Dihydroxydiphenacylamine Hydriodide
pp′-Dihydroxydiphenacylamine Picrate
mm′pp′-Tetrahydroxydiphenacylamine Hydrochloride
mm′pp′-Tetrahydroxydiphenacylamine Hydriodide
mm′pp′-Tetrahydroxydiphenacylamine Picrate

Salts obtained during the Resolution of Benzoyloscine

Benzoyl-*dl*-oscine Hydrochloride
Benzoyl-*dl*-oscine Nitrate
Benzoyl-*dl*-oscine *d*-Camphorsulphonate
Benzoyl-*dl*-oscine Picrate
Benzoyl-*d*-oscine *d*-Bromocamphorsulphonate
Benzoyl-*d*-oscine Hydrochloride
Benzoyl-*d*-oscine Aurichloride
Benzoyl-*d*-oscine Nitrate
Benzoyl-*d*-oscine Picrate

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 α-Glycerylphosphoric Acid
Brucine Salt of β-Glycerylphosphoric Acid

NEW PREPARATIONS OF MANGANESE, IRON AND BISMUTH

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

SALINIGRIN, A GLUCOSIDE FROM THE BARK OF SALIX DISCOLOR, *Muhl.*, AND ITS HYDROLYTIC PRODUCTS

Salinigrin
*meta*Hydroxybenzaldehyde Glucose

SYNTHETIC GLUCOSIDES OF SITOSTEROL, CHOLESTEROL, AND SOME FATTY ALCOHOLS

Sitosterol Sitosterol-*d*-glucoside
Tetra-acetylsitosterol-*d*-glucoside
Tetrabenzoylsitosterol-*d*-glucoside
Cholesterol Cholesterol-*d*-glucoside
Tetra-acetylcholesterol-*d*-glucoside
Ceryl-*d*-glucoside (m.p. 94°)
Ceryl-*d*-glucoside (m.p. 135°)
Myricyl-*d*-glucoside Cetyl-*d*-glucoside
Tetra-acetylcetyl-*d*-glucoside

CHAULMOOGRIC ACID, AND DERIVATIVES

Chaulmoogric Acid
Ammonium Chaulmoograte Dihydrochaulmoogric Acid

SUBSTANCES ISOLATED FROM THE LEAVES OF ERIODICTYON CALIFORNICUM *(Hooker et Arnott)*, *Greene* (" Yerba Santa "), AND THEIR DERIVATIVES

Essential Oil
Pentatriacontane
Glucose (Osazone)
Penta-acetyleriodictyol
Triacontane
Cerotic Acid
Eriodictyol
Monomethyleriodictyol
2 : 4 : 6-Trimethoxyphenyl 3 : 4-Dimethoxystyryl Ketone
(from Eriodictyol)

2-Hydroxy-4:6-dimethoxyphenyl 3:4-Dimethoxystyryl Ketone (from Eriodictyol)
Homoeriodictyol
Monosodiumhomoeriodictyol
Tetra-acetylhomoeriodictyol
Monomethylhomoeriodictyol
Phloroglucinol
Ferulic Acid
2:4:6-Trimethoxyphenyl 3:4-Dimethoxystyryl Ketone (from Homoeriodictyol)
2-Hydroxy-4:6-dimethoxyphenyl 3:4-Dimethoxystyryl Ketone (from Homoeriodictyol)

PRODUCTS OBTAINED DURING THE SYNTHESIS OF METHYL DERIVATIVES OF ERIODICTYOL, HOMOERIODICTYOL, AND HESPERITIN

Hydroxydimethoxydiacetylbenzene
Acetoxydimethoxydiacetylbenzene
Benzoxydimethoxydiacetylbenzene
Hydroxydimethoxydiacetylbenzenephenylhydrazone
2:4:6-Trimethoxyphenyl 3:4-Dimethoxystyryl Ketone (Synthetical)
2-Hydroxy-4:6-dimethoxyphenyl 3:4-Dimethoxystyryl Ketone (Synthetical)

HESPERITIN, AND DERIVATIVES

Hesperitin
Tetra-acetylhesperitin
Sodium Derivative of Hesperitin
2:4:6-Trimethoxyphenyl 3:4-Dimethoxystyryl Ketone (from Hesperitin)
2-Hydroxy-4:6-dimethoxyphenyl 3:4-Dimethoxystyryl Ketone (from Hesperitin)

SUBSTANCES ISOLATED FROM SOLANUM ANGUSTIFOLIUM, *Ruiz et Pavon* ("Duraznillo Blanco"), AND THEIR DERIVATIVES

Triacontane
Phytosterol
Phytosterolin
Tetra-acetylphytosterolin
Tetrabenzoylphytosterolin
Unsaturated Fatty Acids
Palmitic Acid

Cluytinic Acid
Cerotic Acid
Rutin
Dextrose (Osazone) from Rutin
Rhamnose (Osazone) from Rutin
Quercetin from Rutin
Penta-acetylquercetin
3 : 4-Dihydroxycinnamic Acid
3 : 4-Dimethoxycinnamic Acid
l-Asparagine
Glucose (Osazone)
Solangustine
Solangustine Sulphate
Dextrose (Osazone) from Solangustine
Solangustidine Hydrochloride
Solangustidine Hydrobromide
Solangustidine Sulphate
Solangustidine Nitrate
Solangustidine Picrate
Acetylsolangustidine

Substances isolated from Hops, and their Derivatives

Essential Oil
Hentriacontane
Ceryl Alcohol
Phytosterol
Acetylphytosterol
Phytosterolin
Tetra-acetylphytosterolin
Tetrabenzoylphytosterolin
Linolic Acid
Palmitic Acid
Acid, $C_{20}H_{40}O_2$
Cluytinic Acid
Methyl Cluytinate
Cerotic Acid
Methyl Cerotate
*iso*Butyric Acid
Valeric Acid
β-*iso*Propylacrylic Acid
$\alpha\beta$-Dihydroxy*iso*hexoic Acid
Humulol
p-Hydroxybenzaldehyde
Xanthohumol
l-Asparagine
Potassium Nitrate
Glucose (Osazone)

Resinous Products from Hops

Petroleum Extract of the Resin
Ether Extract of the Resin
Chloroform Extract of the Resin
Ethyl Acetate Extract of the Resin
Alcohol Extract of the Resin

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

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

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

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

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 Tinnevelly Senna Leaves, and their Derivatives

Essential Oil
Myricyl Alcohol
Phytosterol
Acetylphytosterol
Phytosterolin
Tetra-acetylphytosterolin
Palmitic Acid
Salicylic Acid
Rhein
Diacetylrhein
Aloe-emodin
Triacetylaloe-emodin
Tribenzoylaloe-emodin
Kaempferol
Tetra-acetylkaempferol
Tetrabenzoylkaempferol
Kaempferin
Kaempferol from Kaempferin
Dextrose (Osazone) from Kaempferin
Magnesium Salt of an Organic Acid
Glucose (Osazone)

Substances isolated from Alexandrian Senna Leaves, and their Derivatives

Rhein
Aloe-emodin
Tetra-acetylkaempferol
*iso*Rhamnetin
Tetra-acetyl*iso*rhamnetin

Substances isolated from Wheat Germ, and Derivatives

Sitosterol
Fatty Oil
Palmitic Acid
Stearic Acid
Linolic Acid
Raffinose
Cane Sugar
Glucose (Osazone)
Betaine Aurichloride
Allantoine
Sinapic Acid

Substances isolated from Veronica Virginica, *Linné* (*Leptandra Virginica*, Nuttall), "Culver's Root," and their Derivatives

Essential Oil
Crude Resin
Bitter Substance
Verosterol
Acetylverosterol
Palmitic Acid
Unsaturated Fatty Acids
Cinnamic Acid
p-Methoxycinnamic Acid
Methyl *p*-Methoxycinnamate
3 : 4-Dimethoxycinnamic Acid
Methyl 3 : 4-Dimethoxycinnamate
d-Mannitol
Hexa-acetyl-*d*-mannitol
Hexabenzoyl-*d*-mannitol
Dibenzoyl-*d*-mannitol
Glucose (Osazone)

Substances isolated from Euphorbia pilulifera, *Linné* ("Queensland Asthma Herb"), and their Derivatives

Essential Oil
Triacontane
Phytosterol
Euphosterol
Acetyleuphosterol
Bromoacetyleuphosterol
Unsaturated Acids
Palmitic Acid
Melissic Acid
Methyl Melissate
Ethyl Melissate
Gallic Acid
Trimethylgallic Acid
Ellagic Acid
Acetylellagic Acid
Quercetin
Penta-acetylquercetin
Phenolic Substance
Glucose (Osazone)

Substances isolated from Caulophyllum thalictroides (*Linné*), *Michaux* ("Blue Cohosh"), and their Derivatives

Essential Oil
Phytosterol
Tetra-acetylphytosterolin
Unsaturated Fatty Acids
Cerotic Acid
Methylcytisine
Methylcytisine Hydrochloride
Methylcytisine Picrate
Methylcytisine Aurichloride
Caulosaponin
Deca-acetylcaulosaponin
Dextrose (Osazone) from Caulosaponin
Caulosapogenin
Monosodiumcaulosapogenin
Monomethylcaulosapogenin
Tetra-acetylcaulosapogenin
Diacetylcaulosapogenin
Monosodiumdiacetylcaulosapogenin
Tetrabenzoylcaulosapogenin
Acid, $C_{16}H_{24}O_3$, from Caulosapogenin
Caulophyllosaponin
Deca-acetylcaulophyllosaponin
l-Arabinose from Caulophyllosaponin
l-Phenylarabinosazone
Caulophyllosapogenin
Dimethylcaulophyllosapogenin
Hexa-acetylcaulophyllosapogenin
Glucose (Osazone)

Substances isolated from Sarsaparilla Root, Jamaica (Smilax ornata, *Hooker fil.*), and their Derivatives

Essential Oil
Enzyme
Sitosterol
Sitosterol-*d*-glucoside
Unsaturated Acids
Sarsapic Acid
Methyl Sarsapate
Potassium Nitrate
Glucose (Osazone)
Sarsasaponin
Sarsasapogenin
Acetylsarsasapogenin
Dextrose (Osazone) from Sarsasaponin

II. BOTANICAL AND MATERIA MEDICA SPECIMENS

Aleppo Galls (*Quercus infectoria*, Olivier + *Cynips gallæ tinctoriæ*, Olivier)
Australian Native Hop Bush (*Daviesia latifolia*, R. Br.)
Blue Cohosh (*Caulophyllum thalictroides*, Linné)
Brucea fruits (*Brucea antidysenterica*, Lam.)
Cascara Sagrada (*Rhamnus Purshianus*, DC.)
Chaulmoogra seeds (*Taraktogenos Kurzii*, King)
" Chinkerinchee " (*Ornithogalum thyrsoides*, Jacq.)
Derris stems (*Derris uliginosa*, Benth.)
" Duraznillo Blanco " (*Solanum angustifolium*, R. et P.)
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)
Hops (*Humulus Lupulus*, 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)
Olive bark (*Olea Europæa*, Linné)
Olive leaves (*Olea Europæa*, Linné)
Queensland Asthma Herb (*Euphorbia pilulifera*, Linné)
Sarsaparilla root, Jamaica (*Smilax ornata*, Hooker f.)
Senna leaves, Alexandrian (*Cassia acutifolia*, Delile)
Senna leaves, Tinnevelly (*Cassia angustifolia*, Vahl)
Strophanthus seed (*Strophanthus Kombe*, Olivier)
Strophanthus seed (*Strophanthus hispidus*, DC.)
Wheat Germ
Willow bark (*Salix discolor*, Muhl.)
" Yerba Santa " (*Eriodictyon Californicum* [Hooker et Arnott], Greene)

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 PSEUDACACIA, *Linné*
21. THE ANATOMY OF THE BARK OF ROBINIA PSEUDACACIA, *Linné*

22. A soluble Manganese Citrate and compounds of Manganese with Iron
23. The chemical characters of so-called Iodotannin Compounds
24. The constitution of Pilocarpine—Part III
25. A new Synthesis of α-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 Dimethylglyoxaline 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 Lævorotatory 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 Hydroxylaminodihydroumbelluloneoxime

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

78. The constituents of the essential oil of Nutmeg

79. Chemical examination of Micromeria chamissonis ("*Yerba Buena*")

80. The constitution of Umbellulone—Part III

81. The constituents of Olive Leaves

82. The constituents of Olive Bark

83. Chemical examination of Ipomœa purpurea

84. The characters of official Iron Arsenate

85. Preparation of a Soluble Ferric Arsenate

86. The constituents of the expressed oil of Nutmeg

87. Chemical examination and physiological action of Nutmeg

88. Some observations regarding "Oleuropein" from Olive Leaves

89. Chemical examination of Eriodictyon—Part II

90. The constituents of the bark of Prunus serotina
91. The constituents of the rhizome of Apocynum androsaemifolium
92. *iso*Amygdalin, and the resolution of its Hepta-acetyl Derivative
93. The action of nitric acid on the ethers of Aromatic Hydroxyaldehydes
94. The synthesis of substances allied to Cotarnine
95. Chemical examination of Elaterium and the characters of Elaterin
96. The tests for purity of Quinine Salts
97. The configuration of Tropine and ψ-Tropine and the resolution of Atropine
98. The constituents of the fruit of Ecballium Elaterium
99. Syntheses in the Epinephrine Series
100. Chemical examination of Jalap
101. The constituents of Rumex Ecklonianus
102. The constituents of Colocynth
103. The constituents of Red Clover Flowers
104. Chemical examination of Pumpkin Seed
105. Chemical examination of Watermelon Seed
106. Chemical examination of Ornithogalum thyrsoides (" Chinkerinchee ")
107. The constituents of the flowers of Trifolium incarnatum
108. The constituents of the leaves of Prunus serotina
109. Synthesis of Cotarnine
110. Note on Gynocardin and Gynocardase
111. Chemical examination of the tuberous root of Ipomœa Horsfalliæ
112. The resolution of Benzoyloscine
113. Note on the constitution of a-Elaterin
114. The constituents of Leptandra
115. The constitution of Eriodictyol, of Homoeriodictyol, and of Hesperitin

116. The synthesis of 2 : 4 : 6-Trimethoxyphenyl 3 : 4-Dimethoxystyryl Ketone
117. The constituents of Gelsemium
118. Syntheses in the Epinephrine Series—Part II
119. The absorption spectra of some substituted Pyrazines and their Salts
120. Action of Sodium Amalgam on Methylene Ethers
121. The constituents of the rhizome of Iris versicolor
122. Chemical examination of the root of Lasiosiphon Meissnerianus
123. The orientation of the Nitro-group in Nitromyristicinic Acid
124. *α*-*p*-Hydroxy-*m*-methoxyphenylamine, and the resolution of *α*-*p*-Hydroxyphenylethylamine
125. The constituents of Withania somnifera
126. The constituents of Rhubarb
127. The constituents of Bryony Root
128. The constitution of Scopoletin
129. The constituents of the bulb of Buphane disticha
130. Some derivatives of Gelsemine
131. Synthesis of 4 : 6 - Dimethoxy - 2 - β - methylaminoethylbenzaldehyde
132. Chemical examination of Oenanthe Crocata
133. The constituents of the seeds of Casimiroa Edulis
134. Chemical examination of Calabar Beans
135. Chemical examination of the leaves of Anona muricata
136. Chemical examination of the root of Ipomœa orizabensis
137. The constituents of commercial Chrysarobin
138. The proposed method of microsublimation for the detection of Aesculin and the identification of Gelsemium
139. Chemical examination of Scammony Root and of Scammony

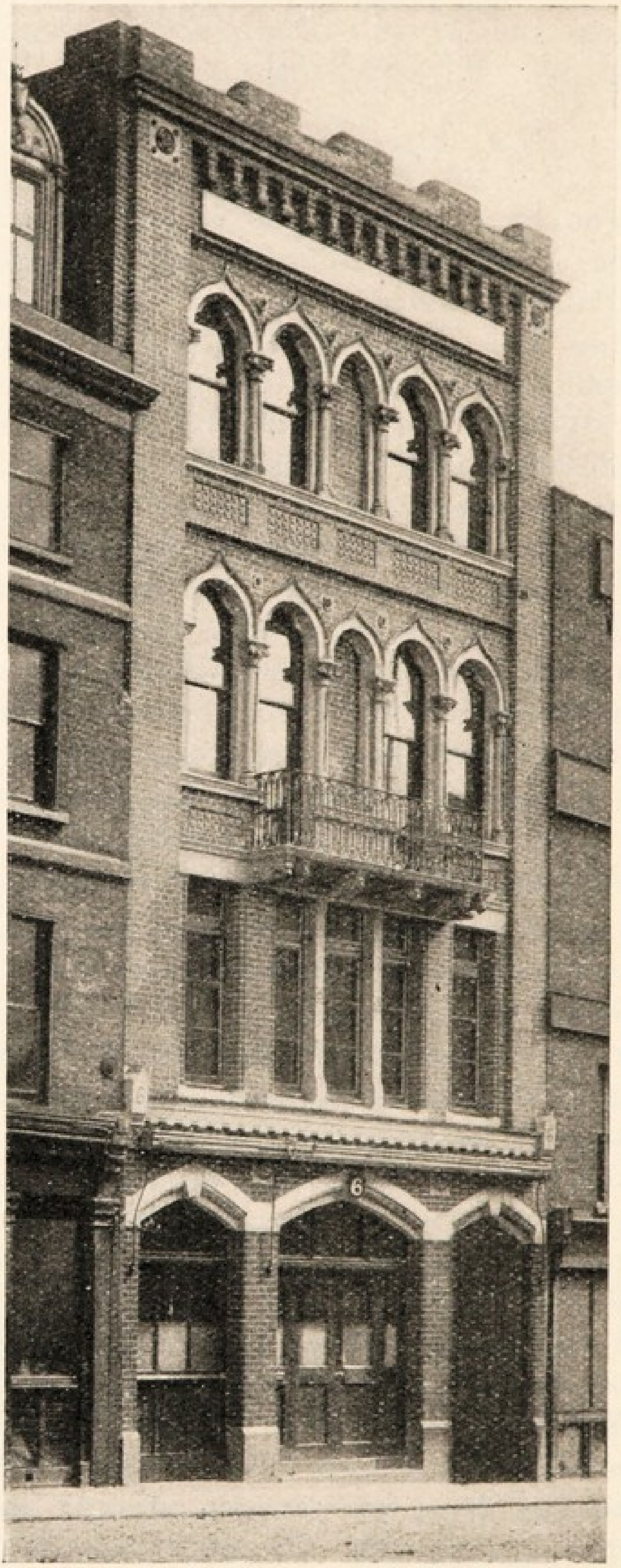
140. Chemical examination of Jambul Seeds
141. The constituents of some Cucurbitaceous Plants
142. Researches on the constitution of Physostigmine—Part I
143. Chemical examination of the bark of Euonymus atropurpureus
144. Chemical examination of the bark of Erythrophlœum Guineense
145. The constituents of Cluytia similis
146. The constituents of Taraxacum Root
147. The constituents of the rhizome and roots of Caulophyllum thalictroides
148. Researches on the constitution of Physostigmine—Part II
149. The identification of Ipuranol and some allied compounds as Phytosterol Glucosides
150. Chemical examination of Euphorbia pilulifera
151. Chemical examination of the roots of Phaseolus multiflorus
152. Chemical examination of Dicoma anomala
153. The synthetical preparation of the *d*-Glucosides of Sitosterol, Cholesterol, and some Fatty Alcohols
154. The constituents of Hops
155. Chemical examination of Wheat Germ
156. The poisonous constituent of the bark of Robinia Pseudacacia
157. The constituents of Senna Leaves
158. Researches on the constitution of Physostigmine—Part III
159. Some derivatives of Oleanol
160. Observations on the constituents of Aloes
161. Chemical examination of Sarsaparilla Root
162. The constituents of Solanum angustifolium
163. The constituents of the leaves and stems of Daviesia latifolia

THE WELLCOME
CHEMICAL RESEARCH LABORATORIES

ORGANISATION, EQUIPMENT AND DEVELOPMENT

Those who have observed the progress of events in recent times 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 and of radio-active substances, 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."



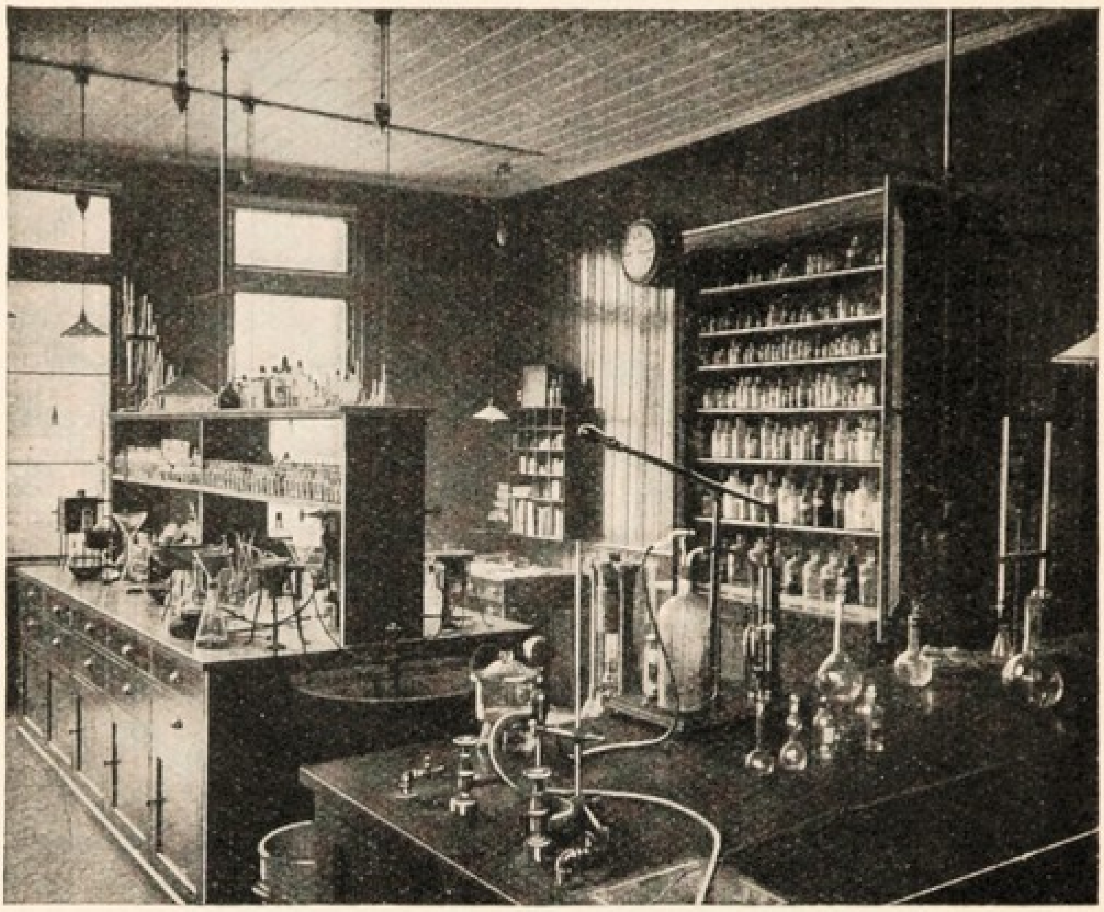
THE WELLCOME CHEMICAL RESEARCH LABORATORIES

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.

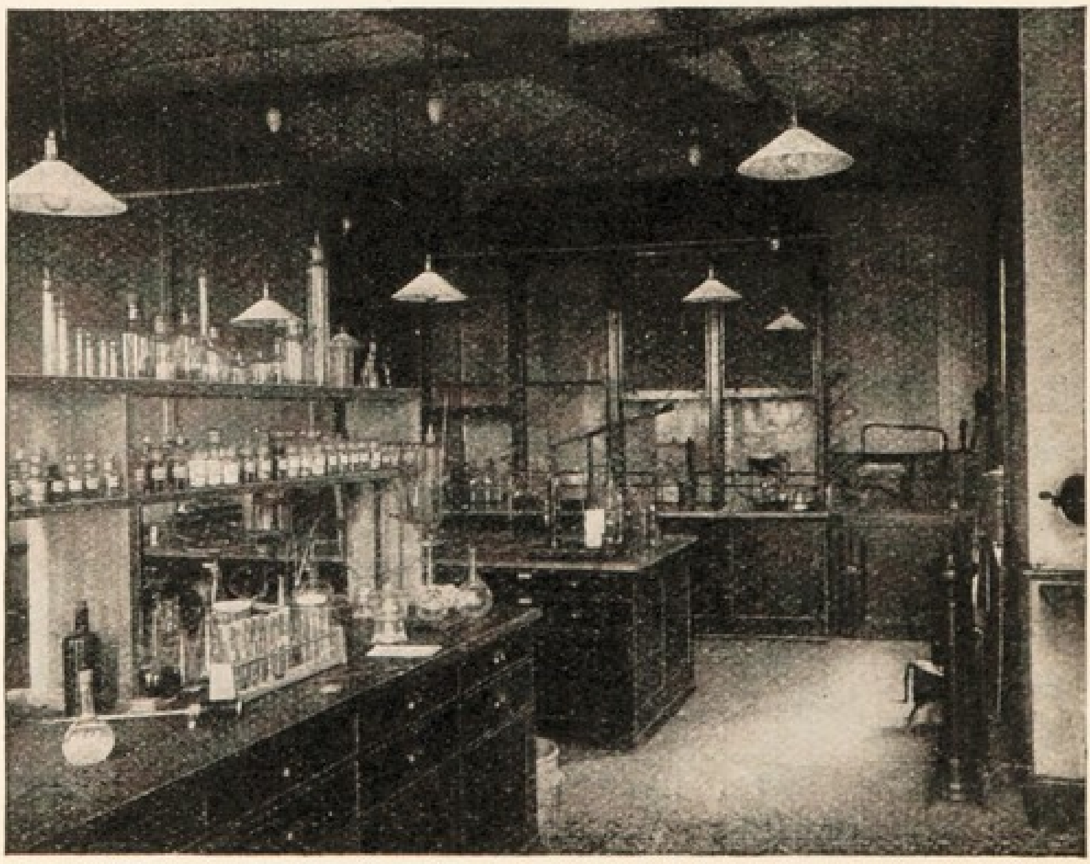
The scope of these laboratories, and the directions in which research is conducted in them, naturally differ. The first-mentioned, for example, is more especially of an academic character, and is therefore devoted to somewhat abstract investigations in chemistry and physics; the second is stated to have 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



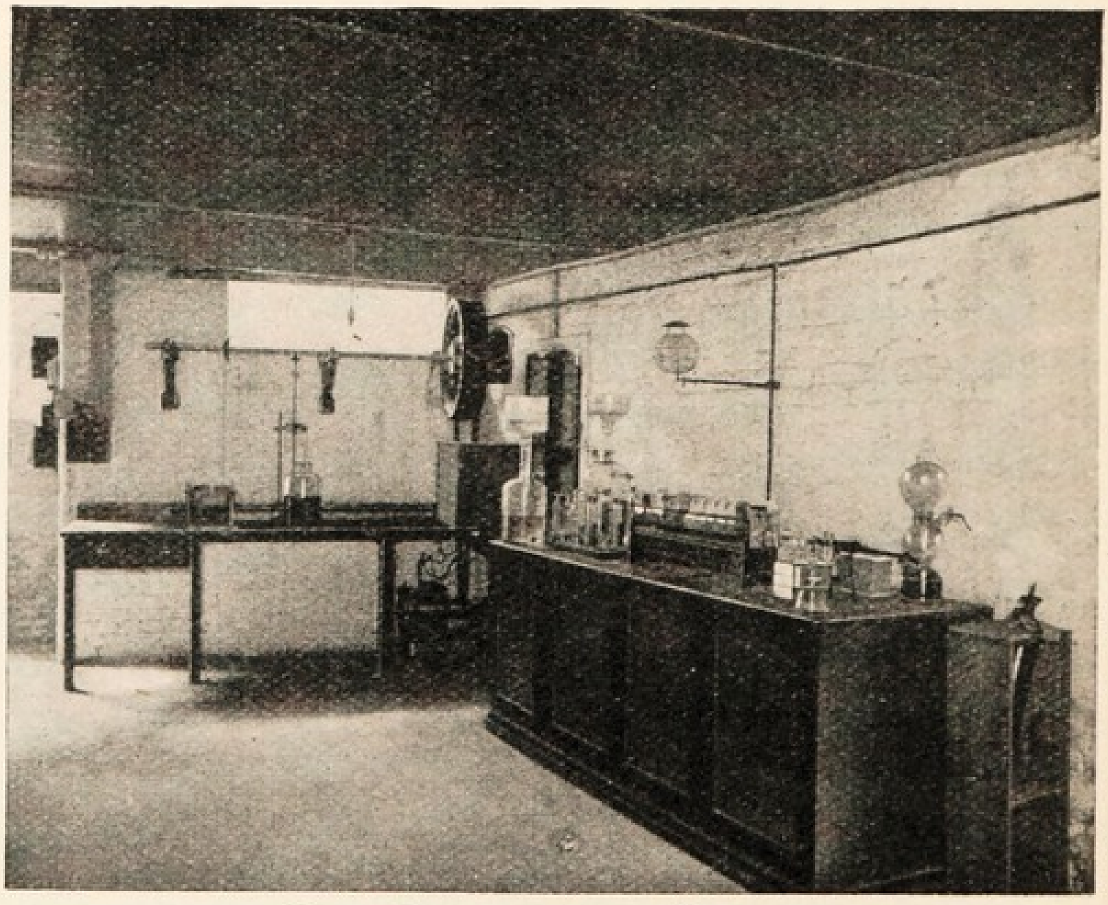
THE LABORATORIES, SECOND FLOOR

The first announcement of Mr. Henry S. Wellcome's plan 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, E.C., 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* 74.

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*, *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* 76 *and* 78. 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 water-baths 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 effected quickly.

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* 78. 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, more than one hundred and sixty publications, embodying the results of original work contributed to various scientific societies, and 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.

AWARDS

CONFERRED UPON THE

WELLCOME CHEMICAL RESEARCH LABORATORIES

AT INTERNATIONAL EXHIBITIONS

ST. LOUIS 1904	ONE GRAND PRIZE THREE GOLD MEDALS
LIÉGE 1905	ONE GRAND PRIZE ONE DIPLOMA OF HONOUR TWO GOLD MEDALS
MILAN 1906	ONE GRAND PRIZE
LONDON (Franco-British) 1908	TWO GRAND PRIZES
LONDON (Japan-British) 1910	ONE GRAND PRIZE
BRUSSELS 1910	THREE GRAND PRIZES ONE DIPLOMA OF HONOUR
TURIN 1911	THREE GRAND PRIZES ONE DIPLOMA OF HONOUR

FOR

CHEMICAL AND PHARMACOGNOSTICAL RESEARCH

ETC., ETC.